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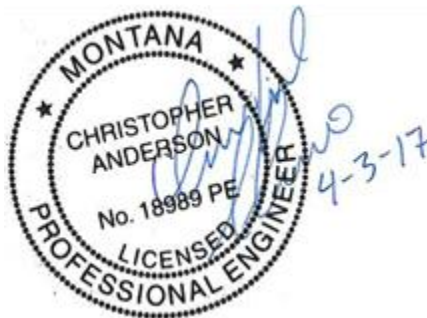
**Project Specifications**  
for the  
**MILLTOWN STATE PARK  
ROADS, TRAILS, & PARKING AREA  
DEVELOPMENT**

MONTANA FISH, WILDLIFE & PARKS

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**Bonner, Montana  
Missoula County, Montana**

April 2017



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## **SECTION 01010**

### **SUMMARY OF WORK**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. The Invitation to Bid contains a general description of the project work to be performed under this Contract. The Supplemental Conditions, Special Provisions, Technical Specifications, and other documents contain additional information necessary to perform the work.

##### **1.2 CONTRACT DOCUMENTS**

- A. Portions of the Contract Documents are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, “Furnish...” means “Contractor shall furnish...”, “Provide” means Contractor shall provide...”.
- B. Contract Documents are defined in Article 1, paragraph 1.1.1, General Conditions.
- C. The Contract Documents are intended to provide the basis for proper completion of the work suitable for the intended use of the Owner. Comply with Article 1, General Conditions. Specifications and Drawings included in these contract documents establish the performance, quality requirements, location and general arrangement of materials and equipment, and establish the minimum standards for quality of workmanship and appearance. Anything not expressly set forth but which is reasonably implied or necessary for proper performance of the project shall be included.
- D. The various portions of the Contract Documents, of which these specifications are a part, are essential parts of the Agreement, and a requirement occurring in any portion or part is binding as though occurring in all. All portions are intended to be complementary and to describe and provide for a complete work as referenced in Article 1, General Conditions. Unless specifically noted otherwise, in the case of discrepancy the hierarchy referenced in paragraph 1.1.1 of the General Conditions shall be observed.
- E. A requirement mentioned in one part/section of the Contract Documents shall be considered as having been mentioned in all parts/sections.

##### **1.3 WORK SEQUENCE**

- A. Comply with paragraph 3.10, General Conditions and Milestones specified in the Contract Documents.

- B. Submit detail schedules as specified in the Contract Documents.
- C. Field verify dimensions indicated on drawings before fabricating or ordering materials. Do not scale drawings.
- D. Notify Engineer/Owner of existing conditions differing from those indicated on the drawings. Comply with paragraph 3.2, of the General Conditions and any Supplementary Conditions. Verify the existence and location of underground utilities along the route of the proposed work. Omission of an existing or previous abandoned utility location on the Drawings is not to be considered as its nonexistence. Inclusion of existing utility locations on the Drawings is not be considered as its definite location. Do not remove or alter existing utilities without prior written approval.

#### 1.4 CONTRACTOR USE OF PREMISES

- A. Comply with paragraph 3.13, General Conditions, and as specified in the Contract Documents.
- B. Do not park vehicles or equipment or store materials on private property without written permission from the property owner. Provide Engineer/Owner with copy of authorization.

#### 1.5 OWNER-FURNISHED ITEMS

- A. Owner-furnished items are listed in the Contract Documents.

#### **PART 2: PRODUCT - NOT USED**

#### **PART 3: EXECUTION - NOT USED**

#### **PART 4: MEASUREMENT AND PAYMENT**

##### 4.1 PAYMENT

- A. Unless specifically noted otherwise, shall be incidental to the work, and no separate payment shall be made.

#### **END OF SECTION**

## SECTION 01030

### PERMITS (added section)

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This section specifies the requirements for securing and complying with all local, state, and federal regulations required for the project. Contractor shall be responsible for obtaining all permits detailed within the contract documents or required by any local, state, or federal regulations unless specifically stated within the contract documents that the Owner will provide. Contractor will be responsible to acquire all permits necessary and pay charges for such, unless otherwise specified. Note that some permits require inspection upon completion by the issuing agency. Coordinate inspection of completed work through the Engineer.

##### 1.2 PERMITS

- A. Permits required, but not necessarily limited to, are as follows:

- 1. Missoula County:

- a. Excavation Permit: Contractors will be required to obtain an excavation permit from Missoula County for the installation of all utilities and site improvements. This includes permits related to storm drainage, paving, concrete curb and sidewalk, and other associated permits.

- 2. Environmental Permits:

- a. MPDES Stormwater Discharge Permit: The Contractor shall be required to secure and pay all fees associated with obtaining Authorization for Storm Water Discharge associated with construction activity under the Montana Pollutant Discharge Elimination System (MPDES). All fees associated with this permit application and any subsequent recurring fees will be paid for by the Contractor. See Section 01600 for additional information.

- 3. Railroad Permits:

MRL Construction Permit: The Contractor shall be required to secure and pay all fees associated with obtaining Authorization for working within the Railroad Right of Way. See Section 01900 Railroad

Coordination for additional information.

**PART 2: PRODUCT - NOT USED**

**PART 3: EXECUTION – NOT USED**

**PART 4: MEASUREMENT AND PAYMENT**

**4.1 PAYMENT FOR PERMITS**

- A. The Contractor shall be required to obtain all permits necessary to complete the project other than those identified to be secured and paid for by the Owner, if any. Measurement and payment for Permits shall be incidental to other items and shall include all fees associated with securing and complying with all permits.

**END OF SECTION**

## **SECTION 01041**

### **PROJECT COORDINATION (added section)**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This section specifies the requirements for coordinating and sequencing the work under the Contract documents, and requirements regarding existing site conditions.

##### **1.2 COORDINATION WITH PUBLIC AND PRIVATE AGENCIES**

- A. Comply with Article 10, General Conditions. Permit utility companies to repair or replace their lines in the project limits.

The Contractor shall be responsible to coordinate utility conflicts with the local gas, electric, phone, and cable companies. The Contractor shall contact these companies immediately following award of the project and provide a preliminary schedule as to when utility relocation/adjustments can be made. The following companies and representatives should be contacted:

North Western Energy – Gas and Electric:

Contact Brent Finneman at North Western Energy, (406) 542-5931

CenturyLink – Telephone:

Contact Jordan Seiffert at Qwest, (406) 255-8302

Charter – Cable TV:

Contact Benny Murphy at Charter, (406) 542-3900

- B. Contact the Montana one-call system for utility locations before starting work.
- C. Comply with paragraph 11.2.2, General Conditions.
- D. Coordinate with Town Pump for construction of temporary access roads, approaches and other activities that may restrict access or have impact to their property. Requirements of construction on and use of Town Pump property will be provided by the owner.

#### **PART 2: PRODUCT - NOT USED**

#### **PART 3: EXECUTION - NOT USED**

#### **PART 4: MEASUREMENT AND PAYMENT - NOT USED**



**END OF SECTION**

## **SECTION 01050**

### **FIELD ENGINEERING**

#### **PART 1: GENERAL**

##### **1.1 ENGINEERING SURVEYS**

- A. Survey work will be performed by the FWP's consultant. Notify Engineer of required survey work at least 48 hours before it is needed. The following items will be staked once by the consultant:
  - a) Concrete curb and gutter
  - b) Concrete sidewalk
  - c) "Curb laydown" locations
  - d) Drainage structures
  - e) Fences
  - f) Roadway and trail centerlines
  - g) Roadway and trail slope stakes– minimum 50' intervals with ref. points
  - h) Roadway and trail grade stakes– minimum two per cross section at 50' intervals
  - i) Parking areas – grade stakes and construction limits
  - j) Retaining walls– offset stakes to wall hinge point
  - k) Pavilion Building Footprint
  - l) Special ditch grades
  - m) Signs
  - n) Benches, picnic tables, and other ancillary features.
- B. The contractor shall bear all expenses associated with replacing destroyed stakes that have been set by FWP's consultant.
- C. Preserve all benchmarks, control points and stakes.
- D. Replace benchmarks, control points and stakes destroyed or disturbed by the Contractor or subcontractor. If existing control points or stakes are disturbed, the contractor will be responsible for the replacement of such monuments at no additional expense to FWP.

##### **1.2 STREET MONUMENTS AND PROPERTY CORNERS**

- A. Protect existing property pins and/or other monuments. If existing property pins and/or other monuments are disturbed during construction activities, the contractor will be responsible for the replacement of such monuments at no additional expense to FWP.
- B. Use a licensed land surveyor to replace all property corners or other monuments marked or shown on the plans that are destroyed by the work.

**PART 2:     PRODUCT - NOT USED**

**PART 3:     EXECUTION - NOT USED**

**PART 4:     MEASUREMENT AND PAYMENT - NOT USED**

**END OF SECTION**

## **SECTION 01090**

### **REFERENCES**

#### **PART 1: GENERAL**

##### **1.1 COORDINATION OF CONTRACT DOCUMENTS**

##### **1.2 DEFINITIONS**

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
- 1 . Addenda-Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirement or the Contract Documents.
  - 2 . Bidding Documents-The Bidding Requirements and the proposed Contract Documents (including all Addenda).
  - 3 . Contract-The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.
  - 4 . Contract Documents-Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
  - 5 . Contractor-The individual or entity with whom Owner has entered into the Agreement.
  - 6 . Drawings-That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.
  - 7 . Owner-The individual or entity with whom Contractor has entered into the Agreement for whom the Work is to be performed.
  - 8 . Samples-Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
  - 9 . Shop Drawings-All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for the Contractor and submitted by Contractor to illustrate some portion of the Work.
  - 10 . Substantial Completion-The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of the Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance

with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.

- 11 . Underground Facilities-All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

### 1.3 REFERENCES

- A. This section lists some of the construction industry organizations, professional and technical associations, societies and institutes, and government agencies issuing, promoting, or enforcing standards in the Contract Documents along with the abbreviations commonly used for those references. Also included are general requirements for using industry standards specified, and for applying quality control standards.

### 1.4 USE OF REFERENCE STANDARDS

- A. Work specified by reference to a published standard or specification of a government agency, technical association, trade association, professional society or institute, testing agency, or other organization must meet or exceed the minimum quality standards for the material and workmanship in the designated standard or specification.
- B. Where specified, assure products or workmanship meet the prescriptive or performance requirements in the Contract Documents when it is a more stringent standard than the referenced standard. Contract should reference only one specification to prevent argument as to which specification is most stringent.
- C. Where the specific issue date of the standard is not identified in the standard, the edition and all published amendments available on the date of the Invitation to Bid applies.
- D. If two or more standards are specified, provide the product and workmanship meeting or exceeding the requirements of the most stringent standard.
- E. If a conflict exists between standards, meet the more stringent standard.
- F. Where both a standard and a brand name are specified, assure the proprietary product names meet or exceed the specified reference standard. The listing of a trade name in a Contract Document does not warrant that the product meets the referenced standard.

G. Copies of Standards

1. Copies of applicable referenced standards are not bound in this Contract Document.
2. Where the contractor needs copies of standards for work superintendence and quality control, obtain a copy or copies directly from the publication sources and maintain copies at the job site, making them available to Contractor personnel, subcontractors, Owner, and Engineer.

1.5 ABBREVIATIONS

- A. Abbreviations for Trade Organizations and Government Agencies: Following is a list of construction industry organizations and government agencies commonly referenced in the Contract Documents, with abbreviations used.

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturers' Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGA	American Gas Association
AGMA	American Gear Manufacturers' Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALS	American Lumber Standards
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute

ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers' Association
AWPB	American Wood Preservers' Bureau
AWPI	American wood Preservers' Institute
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers' Association
CBMA	Certified Ballast Manufacturers' Association
CDA	Copper Development Association
CGA	Compressed Gas Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturer's Association of America
CRSI	Concrete Reinforcing Steel Institute
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
Fed Spec.	Federal Specifications
FS	Federal Specification
GA	Gypsum Association
HI	Hydraulic Institute
HMI	Hoist Manufacturers' Institute
ICBO	International Conference of Building Officials
ICEA	Insulated Cable Engineers' Association
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IES	Illuminating Engineering Society of North America
ISA	Instrument Society of America
JIC	Joint Industry Conferences of Hydraulic Manufacturers
MIA	Marble Institute of America
Mil. Sp.	Military Specification
MS	Military Specifications
MMA	Monorail Manufacturers' Association
NAAMM	National Association of Architectural Metal Manufacturers
NBHA	National Builders' Hardware Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NHLA	National Hardwood Lumber Association
NLMA	National Lumber Manufacturers' Association
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers' Association
OECI	Overhead Electrical Crane Institute

OSHA	Occupational Safety and Health Act (both Federal and State)
PEI	Porcelain Enamel Institute
PS	Product Standards Section - U.S. Department of Commerce
RLM	RLM Standards Institute, Inc.
RMA	Rubber Manufacturers' Association
SAE	Society of Automotive Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joint Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
SWI	Steel Window Institute
TEMA	Tubular Exchanger Manufacturers' Association
TCA	Tile Council of America
UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriters' Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WWPA	Western Wood Products Association

**PART 2: PRODUCT - NOT USED**

**PART 3: EXECUTION - NOT USED**

**PART 4: MEASUREMENT AND PAYMENT - NOT USED**

**END OF SECTION**



## **SECTION 01300 SUBMITTALS**

### **PART 1: GENERAL**

#### **1.1 CONSTRUCTION SCHEDULES**

- A. Submit to the Engineer a progress schedule under Sections 3.10 of the General Conditions.
- B. Submit to the Engineer adjusted progress schedules under Section 3.10 of the General Conditions.
- C. Submit to the Engineer, value schedules under Sections 9.2 of the General Conditions.

#### **1.2 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES**

- A. When applicable, submit shop drawings to the Engineer under Sections 3.12 of the General Conditions. Submit all shop drawings for the Contractor, subcontractor(s) and supplier(s).
- B. Review all shop drawings prior to submittal in accordance with Section 3.12.3 and 3.12.4 of the General Conditions.
- C. Submit in writing any substitutions to previously approved items for review by the Engineer.
- D. Within 15 days after Notice to Proceed, submit a complete list of products proposed for use, providing manufacturer's name, trade name, and model or catalog numbers, and manufacturer data.  
  
Submit the number of copies needed by the Contractor, plus three copies for Engineer use.
- E. Where specified, submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices.

Where specified, submit samples of finishes including colors, textures, and patterns.

### **PART 2: PRODUCT - NOT USED**

### **PART 3: EXECUTION - NOT USED**

### **PART 4: MEASUREMENT AND PAYMENT - NOT USED**

**END OF SECTION**

## **SECTION 01400**

### **CONTRACTOR QUALITY CONTROL AND QUALITY ASSURANCE**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This section describes the Contractor quality control testing requirements and Owner's quality assurance program.

##### **1.2 REFERENCES**

- A. The following ASTM publication is a part of this specification.

ASTM E 329 Evaluation of Testing and Inspection Agencies as Used in  
Construction

#### **PART 2: PRODUCT - NOT USED**

#### **PART 3: EXECUTION**

##### **3.1 GENERAL**

- A. Be responsible for quality control tests and inspections to control contractor production and construction processes. Include in the Contractor quality control system an internal organization, plans, and procedures to produce the specified end product. Assure the system covers all construction operations, both on-site and off-site, and is keyed to the construction sequence. Quality control testing frequency is at Contractor discretion, except as specified below, or as requested by the Engineer.
- B. Sampling and testing to assure specification conformance may be performed by the Owner's consultant as quality assurance testing.
- C. The Owner may select an independent testing agency to perform quality assurance testing. (ASTM E329 is referenced as a guide to the selection of a qualified testing agency.) The Owner will pay for (or provide) the quality assurance testing. Quality assurance testing frequency is at Owner discretion for individual products. Owner's quality assurance testing does NOT relieve the Contractor of the obligation to perform quality control testing.
- D. Quality assurance testing is performed following the standards in the technical specifications for individual products.

### 3.2 TESTING REQUIREMENTS

- A. Furnish documentation of tests in accordance with methods prescribed by AASHTO for theoretical maximum density, optimum moisture content, and sieve analysis for the surfacing/cushion material, the imported base material, and excavation backfill material within the right-of-way or surrounding pipe.
- B. In place density tests for trenches and embankments shall, as a minimum, be required for the first lift of backfill to set a pattern of compaction, shall be provided daily, and as backfill material changes. In place density tests shall, as a minimum, be required at intervals of two hundred (200') feet. Tests shall be provided for subgrade, base, and cushion materials. A minimum of the top six (6") inches of subgrade which are to be paved or covered with sidewalk, curb and gutter shall be field density tested until the material no longer responds to compactive efforts and shall be 95% of proctor. All trench backfill material in improved areas and all embankments shall be compacted for the full depth and shall be compacted to 95% of the theoretical maximum proctor density as determined by AASHTO T-99 or ASTM D698. All trench backfill material in unimproved areas shall be compacted to 85% of the theoretical maximum proctor density
- C. furnish portland cement concrete tests for concrete placed in the public right-of-way and concrete incorporated into public infrastructure improvements. One set of tests shall be required for every fifty (50) cubic yards of concrete placed with a minimum of one set of tests per project. The concrete shall be sampled, specimens made, and compliance determined in accordance with the following:

Sampling Fresh Concrete	ASTM C-172
Slump	ASTM C-143 or AASHTO T119
Air Content	ASTM C-231 or C-173 or C-138 or AASHTO T152
Compressive Strength	ASTM C-39 or AASHTO T22
Making and Curing Test	ASTM C-78 or AASHTO T97
- D. Assure that the Contractor or its independent quality control testing agency provides written reports of all required tests to the Engineer.

### 3.3 CONTRACTOR COOPERATION WITH QUALITY ASSURANCE AGENCY

- A. Assure the Owner's personnel and quality assurance agency have access to all work areas at all times work is in progress. Provide any special facilities or equipment to access work areas at Contractor expense.
- B. Notify the Engineer of the work ready for quality assurance testing. Establish and update as the construction schedule to provide the Engineer estimated

sampling/testing dates and times.

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 PAYMENT FOR TESTING**

- A. Pay for quality control testing as outlined in Part 3 above. Quality control testing will not be measured but will be paid for as a Lump Sum. Payment includes full compensation for all materials, labor, and incidentals required to complete the work.
- B. Owner will provide initial quality assurance testing at its own expense.

##### **4.2 RETESTING**

- A. Quality assurance re-testing due to failing initial tests will be performed by the Owner's consultant, and the re-test costs deducted from the contract amount for the affected bid item.

**END OF SECTION**

## **SECTION 01500**

### **CONSTRUCTION AND TEMPORARY FACILITIES**

#### **PART 1: GENERAL**

##### **1.1 CONSTRUCTION FACILITIES**

- A. Furnish temporary services and utilities, including use fees and operation costs for: potable and non-potable water; lighting and power; and, materials storage.
- B. Furnish personnel support facilities including: sanitary facilities; drinking water; first aid supplies and facilities; and, trash removal.
- C. Do not park vehicles or equipment or store materials on private property without written permission from the property owner.

##### **1.2 SECURITY**

- A. Provide fencing, barricades, warning signs, and lights to secure all work areas, equipment, and materials.

##### **1.3 DUST CONTROL**

- A. Be responsible for dust control, providing all equipment and personnel for the work. Furnish Engineer with the name(s) and telephone number(s) of the person(s) responsible for dust control during evenings and weekends. If this person cannot be contacted, Owner may at Contractor expense, perform the work or contract the work out.

##### **1.4 HAUL ROUTES**

- A. Obtain Owner approval of haul routes. The haul route across Town Pump property will be identified by the Owner prior to construction.

##### **1.5 TEMPORARY RAILROAD CROSSING**

- A. Temporary access across Burlington Northern Santa Fe (BNSF) property is defined in the contract documents. Coordinate all work with Montana Rail Link (MRL) as defined in Section 01900 Railroad Coordination.

#### **PART 2: PRODUCT - NOT USED**

#### **PART 3: EXECUTION - NOT USED**

#### **PART 4: MEASUREMENT AND PAYMENT**

#### 4.1 PAYMENT

- A. All items in Part 1 are incidental to the work and no separate payment is made for these items unless shown as bid items in other Specification Sections.

**END OF SECTION**

## **SECTION 01570**

### **CONSTRUCTION TRAFFIC CONTROL**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This work is the furnishing of labor, materials and equipment for installing, maintaining and operating traffic control devices to insure the safety of the general public and project personnel.

##### **1.2 REQUIREMENTS**

- A. Perform work under this section meeting Manual of Uniform Traffic Control Devices (MUTCD) and contract requirements.

##### **1.3 NOTIFICATIONS**

- A. Coordinate all construction activities to reduce traffic conflicts at the work site, off-site events or other construction projects.
- B. Furnish the Engineer, for Owner review, the construction traffic control plan at least one week before construction begins or before changes in segments or phases of the work on the project. Details of anticipated traffic control measures for this project are contained in the Drawings. Submit any proposed changes to these details to the Engineer for approval. The Engineer will review and approve the Traffic Control Plan considering known off-site activities and may require modification to the plan or construction timing to coordinate events. Work shall not commence until said plan is approved.
- C. Notify all landowners or residents adjacent to the work of the type and duration of the construction.

#### **PART 2: PRODUCT**

##### **2.1 TRAFFIC CONTROL DEVICES**

- A. Assure all signs and barricades are reflectorized. Assure all night time traffic control devices meet MUTCD lighting requirements.
- B. Use traffic control devices meeting the “Manual of Uniform Traffic Control Devices” and the “Traffic Control Devices Handbook” requirements, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20492.
- C. Assure all traffic control devices are clean, legible, reflective for night-time use, and operable.

#### **PART 3 EXECUTION**

##### **3.1 WORK METHODS**

- A. The contractor will be allowed to close Juniper Drive at the intersection of Juniper and the Access Road. This closure may last until the project reaches substantial completion.
- B. Place all traffic control devices as planned before permitting men or equipment on the travel way. Install signs, cones and barricades in that order.
- C. Inspect the work area for appropriate traffic control devices and placement of those devices at least twice each day during construction and maintain records of traffic control devices used and their location. Update traffic control devices and their placement as needed after inspection.
- D. Assure traffic control is appropriate to the work. Assure traffic control devices are appropriate and clean before suspending work for the day.
- E. Remove traffic control devices in reverse order of installation at the end of each shift.
- E. Remove and store all unnecessary traffic control devices away from traffic's view.

### 3.2 NONCOMPLIANCE

- A. Remove, repair or replace any traffic control device not providing its intended function.
- B. Do not begin work until all required traffic control devices are placed.
- C. The Engineer will periodically inspect the traffic control and inform the Contractor of any deficiencies. Contractor shall not rely on the Engineer to conduct inspections to assure proper traffic control is in place.
- D. Contractor failure to correct any deficiency in the traffic control within 4 hours of notification is cause to deduct monies from the contract payment on the next progress payment.
- E. The Engineer may direct correcting traffic control deficiencies immediately. Failure to immediately correct the deficiency is cause for the Engineer to correct the deficiency at Contractor expense.

### 3.3 FLAGGING

- A. Furnish competent and properly equipped flag persons as described in the booklet "Instructions for Flag persons" furnished by the Montana Department of Transportation.
- B. Conform to all railroad flagging requirements outlined in Section 01900.



**PART 4: MEASUREMENT AND PAYMENT**

**4.1 PAYMENT**

- A. All items associated with construction traffic control are considered incidental to the work. No separate measurement or payment will be made.

**END OF SECTION**

## **SECTION 01600**

### **SOIL EROSION AND POLLUTION CONTROL**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This work is the furnishing of labor, materials and equipment for installing, maintaining and operating soil erosion and pollution control measures to minimize sediment transport due to accelerated erosion, siltation, and dust associated with construction activity.

##### **1.2 REFERENCES**

- A. ASTM – American Society for Testing and Materials, including documents referenced, form a part of this Section to the extent designated herein.

##### **1.3 STORM WATER ASSOCIATED WITH CONSTRUCTION ACTIVITY**

- A. The Contractor is responsible for creating and filing Notice of Intent (NOI) and Storm Water Pollution Prevention Plan (SWPPP) for this project under the Montana Pollutant Discharge Elimination System (MPDES) with the Montana Water Quality Division for storm water associated with construction activities. All fees associated with this permit application and any subsequent annual fees will be paid for by the Contractor.
- B. The Contractor shall be required to comply with all requirements of the 2007 “General Permit for Storm Water Discharges Associated with Construction Activity” (General Permit). The Contractor shall review and have an understanding of the SWPPP and its intent for mitigating erosion and sediment control. The Contractor is responsible for installing, maintaining and preserving all erosion control measures for the project in conformance with the SWPPP and any Montana Department of Environmental Quality regulations related to storm water discharge. The Contractor shall be responsible for performing all Monitoring, Reporting, and Records Retention Requirements per Part III of the General Permit. The Contractor shall be responsible to make any necessary changes to the SWPPP to prevent damage as a result of storm water runoff from this site using Best Management Practices.
- C. The Contractor must have a copy of the NOI Receipt Confirmation Letter from DEQ providing coverage to discharge storm water under the General Permit, a copy of the SWPPP, and copies of the Contractor’s reporting documentation on site at all times during construction. The Contractor is solely responsible for any and all damages and/or fines that may result from the runoff from this site during the duration of this contract. The Contractor shall provide all monitoring and reporting records to the Engineer at the completion of the project.

- D. The Contractor shall be responsible to maintain all erosion control measures throughout the warranty period. Once final stabilization of the project is complete, the Contractor shall be responsible to remove erosion control measures that are no longer necessary to contain sediment. The Contractor shall notify the Engineer, prior to the end of the warranty period, when such erosion control measures will be removed, and this work shall be considered an item covered by the project warranty.
- E. Comply with all applicable requirements of local, state, and federal agencies. Comply with the State of Montana DEQ, Water Quality Act 75-5-318 MCA.
- F. Any penalties due to non-compliance with the general permit requirements shall be the responsibility of the Contractor.
- G. The Contractor is responsible to submit Notice of Termination (NOT) when the construction activity is complete and the site has achieved final stabilization.

#### 1.4 QUALITY ASSURANCE

- A. Submit an erosion and sedimentation control plan showing devices, measures, and locations intended for use.
- B. Submit the erosion and sedimentation control plan to the Engineer 10 days prior to the pre-work meeting. At a minimum, the erosion and sediment control plan should include the following:
  - i. Describe the construction activities and sequence of implementation relating to specific erosion control measures.
  - ii. Describe the location and type of temporary controls to be implemented during construction.
  - iii. Describe what monitoring will take place. There will be no contractor delay in response to mitigation of failed erosion control measures.
  - iv. Describe the measures that will be taken to minimize erosion and sediment delivery from material stockpiles.
- C. The erosion control plan must specifically address proposed erosion control devices and measures for construction to the satisfaction of the Engineer.
- D. Comply with all applicable requirements of local, state and federal agencies.
- E. Comply with the State of Montana DEQ, Water Quality Act 75-5-318 MCA.

### **PART 2: PRODUCT**

#### 2.1 MATERIALS

- A. Straw wattles or straw bales used by the Contractor to provide temporary erosion

control as specified under this section must be certified weed free. Certification must be provided to the Engineer prior to installation.

- B. DO NOT USE silt fence for sediment and erosion control unless otherwise approved by the Engineer.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Ensure that every precaution will be taken, through project completion, to minimize the effects of site erosion and the potential for damage to adjacent property or bodies of water.
- B. Install straw wattles per manufacturer's recommendations such that water will not go under or around wattle installations.

## **PART 4: MEASUREMENT AND PAYMENT**

### **4.1 PAYMENT**

- A. Measurement and payment for the Contractor's erosion control plan and all associated components is on a lump sum basis. The lump sum payment is full reimbursement for all costs of furnishing, installing, maintaining, replacing and operating the components of the erosion control systems throughout the work period. Creating and filing all documentation required under the MPDES for storm water associated with construction activities, associated fees and all work associated with soil erosion and sediment control shall be included in the lump sum.
- B. Progress payments are in proportion to total construction completed.

**END OF SECTION**

## **SECTION 01700**

### **CONTRACT CLOSEOUT**

#### **PART 1: GENERAL**

##### **1.1 CLEANUP**

A. Before Final inspection (as outlined in Section 9.10 of the General Conditions) execute the following.

1. Remove debris, waste, surplus materials, and rubbish from right-of-way, easements (construction or permanent) and private property.
2. Where applicable, remove debris, dirt, and silt from storm drain basins, sanitary sewer and storm drain manholes, and water valve boxes.
3. Rake landscaped surfaces clean of debris.
4. Where applicable, remove temporary coverings from permanent traffic control devices.
5. Clean permanent traffic control devices and signs.
6. Where applicable, remove temporary traffic striping.
7. Sweep dirt and debris from all constructed sidewalk, curb & gutter, and from paved areas affected by the work.

##### **1.2 RECORD DOCUMENTS**

- A. Submit record documents as outlined in the General Conditions. Final payment will not be processed until the documents are submitted to and approved by the Engineer.

##### **1.3 OPERATION AND MAINTENANCE DATA**

- A. Where applicable, submit two sets, before final inspection, bound in three ring binders. Prepare a table of contents for each volume with each product or system identified.
- B. Where applicable, prepare the following:
1. Directory, listing names, addresses and telephone numbers of Engineer, Contractor, Subcontractor, and Equipment Suppliers.
  2. Operations and maintenance instructions, arranged by system. For each category, identify the applicable Contractor(s) or Subcontractor(s) and suppliers. Identify the following:
    1. Significant design criteria

2. List of equipment
3. Parts list for each component
4. Operating instructions
5. Maintenance instructions

#### 1.4 WARRANTIES AND BONDS

- A. Submit, with final payment request, all warrant certificates, lien releases, and consent of security forms.

**PART 2: PRODUCTS - NOT USED**

**PART 3: EXECUTION - NOT USED**

**PART 4: MEASUREMENT AND PAYMENT - NOT USED**

**END OF SECTION**

## **SECTION 01710**

### **MOBILIZATION**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This work consists of moving personnel, equipment, material, and incidentals to the project and performing all work necessary before beginning work at the project site. It also includes the removing of personnel, equipment, material, and incidentals from the project site once the work has been completed as well as the general clean-up of the project site. Mobilization includes the obtaining of insurance and bonds required in the contract.

#### **PART 2: PRODUCT - NOT USED**

#### **PART 3: EXECUTION - NOT USED**

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 MEASUREMENT**

- A. Measure mobilization by the lump sum.

##### **4.2 PAYMENT**

- A. Mobilization will be paid for as follows:
  - a) Fifty percent of the lump sum, not to exceed 5 percent of the original contract amount, will be paid following completion of 5 percent of the original contract amount, not including mobilization.
  - b) Payment of the remaining portion of the lump sum, up to 10 percent of the original contract amount, will be paid following completion of 10 percent of the original contract amount, not including mobilization.
  - c) The lump sum price of mobilization may not exceed 10 percent of the base bid schedule total contract amount.

**END OF SECTION**

## **SECTION 01800**

### **MISCELLANEOUS WORK**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This item consists of any necessary work and/or materials encountered during construction that is not addressed elsewhere in the contract.
- B. The inclusion of miscellaneous work in this contract does not guarantee that additional work will be requested by the Owner or that this item will be used by the Engineer.

#### **PART 2: PRODUCT - NOT USED**

#### **PART 3: EXECUTION - NOT USED**

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 MEASUREMENT**

- A. Miscellaneous work will be measured by the respective unit for material and/or work performed as directed by the Engineer.

##### **4.2 PAYMENT**

- A. Payment for miscellaneous work will be at agreed prices or on a force account basis. The number of units in dollars defined in the contract, is an estimated amount only which may be adjusted up or down by the Engineer in accordance with the needs of the project. Use of this item is at the sole discretion of the Engineer. The inclusion of miscellaneous work in this contract does not guarantee the contractor payment for this item except as mutually agreed upon between the Engineer and the contractor. If this item is not used, no payment to the contractor will be made for this item.

**END OF SECTION**



## **SECTION 01900**

### **RAILROAD COORDINATION**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This special provision describes the requirements for coordinating and sequencing work under the contract documents that is located on Montana Rail Link Railroad, herein called the MRL, controlled right-of-way.
- B. This work includes construction of the temporary access road by the Contractor, installation of temporary at-grade crossing over MRL mainline tracks by the railroad and construction by the Contractor of retaining walls, protective roof over the trail crossing under MRL Bridge 113.1, trail adjacent to the west abutment at MRL Bridge 113.1, and construction by the contractor for a protective roof over the road crossing under MRL Bridge 114.1.
- C. The Department of Fish, Wildlife and Parks, herein called the Owner, has entered into an agreement, herein called Railroad Agreement, with MRL and this is included as part of the contract documents. The Contractor shall perform all work on railroad property in accordance with the requirements included in the Railroad Agreement, and as indicated in this provision, whichever is more restrictive.
- D. The Contractor must comply with all of the Railroad requirements that are current at the time of the bid. If there are any conflict between this specification and the requirements of the Railroad, the current railroad requirements at the time of the bid will govern on the project.

##### **1.2 RAILROAD COORDINATION**

- A. The Contractor shall notify MRL at least thirty (30) days in advance of the date on which work is expected to start on the railroad right-of-way. Written approval from MRL and the Engineer are required prior to mobilizing and beginning the work.
- B. Furnish signed copies of the "Contractor Requirements and Acknowledgment for Working on Railroad Right of Way". The document will be provided by the Owner or may be obtained from MRL prior to construction.
- C. Provide advance notice, as agreed to between the Contractor and railway officials, before working on railway property or hauling across railway tracks.
- D. Furnish insurance for all work performed as required in Subsection 1.5 or the contract. Make arrangements with MRL for railway crossings not specified in the contract at Contractor expense. No work shall commence on MRL right-of-way without an approved insurance policy.

- E. Contact information for coordination of work with MRL will be identified by the Engineer at the pre-construction meeting.

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### 1.3 CONSTRUCTION PLAN AND SCHEDULE

- A. The Contractor shall prepare and submit a detailed construction plan and schedule for all work occurring on MRL property. Submit the proposed plan and schedule to the Engineer and MRL for approval at least thirty (30) days prior to beginning the work. The submittal requires approval from the Engineer and MRL in order to commence work on MRL property.
- B. The construction plan shall clearly indicate the proposed methods of construction, type of equipment that is proposed, duration of construction activities and location of materials that might be stockpiled on or near railroad property.
- C. The construction plan shall include names and occupations of all personnel working on railroad property. The plan shall demonstrate that those workers have the appropriate railroad training certifications.
- D. Written approval from the Engineer and MRL is required to begin the work.

### 1.4 EMERGENCY ACTION PLAN

- A. The Contractor shall develop and submit an emergency action plan indicating the location of the site, contact names and phone numbers, access to the site, instructions for emergency response, and location of the nearest hospitals. The plan shall also cover the Contractor's means of fire suppression that may include the phone number and location of the nearest fire department. The plan shall cover all items required in the event of an emergency at the site.

### 1.5 INSURANCE REQUIREMENTS

- A. Furnish Railroad Protective Liability Insurance on behalf of MRL when equipment or personnel are located or work is done on any MRL right of way. Insurance coverage shall comply with the requirements included in the Railroad Agreement.

- B. Submit copies of the Railroad Protective Liability Insurance policy and a certificate of insurance for transmittal to and approval by MRL. Do not use or enter MRL property until MRL approval is received and the policies are in effect. This applies to all work done as a part of the project.
- C. The insurance requirements are a condition precedent to the contract. Failure to obtain and maintain all required insurance, or permitting the insurance to lapse before the contract is complete and accepted is considered a material breach of the contract.

## 1.6 RAILROAD REQUIREMENTS

- A. Comply with the rules and regulations of MRL and the instructions of the MRL's representatives in relation to the proper manner of protecting the tracks and property of MRL and the traffic moving on such tracks, as well as the wires, signals, and other property of MRL, its tenants or licensees, at and in the vicinity of the work area during construction.
- B. Perform work in such manner and at such times that do not endanger, delay or interfere with the safe and timely operation of the tracks and property of MRL and the traffic moving on such tracks, as well as the wires, signals, and other property of MRL its tenants, or licensees.
- C. Take protective measures as are necessary to keep railroad facilities, including track ballast, free of sand, debris, and other foreign objects and materials resulting from the construction operations. MRL may choose to repair damage to railroad facilities resulting from Contractor's operations with the cost being borne by the Contractor.
- D. Personnel working on railroad property shall have the appropriate current railroad safety training certifications as required by the Railroad Agreement.

## 1.7 FLAGGING PROTECTION

- A. Railroad Flagging is required for all construction activities that are located within 25-feet measured horizontally from the centerline of the nearest track and activities that have the potential to foul this zone.
- B. Railroad flagging is required for all operations involving the installation of soldier piles, lagging, and excavation for the retaining wall at Bridge 113.1. Railroad flagging is also required for operations that involve attaching the roof structure to the both the Bridge 113.1 & 114.1 superstructures.
- C. Schedule work and coordinate flagging requirements with the railroad as set forth in Railroad Agreement. The Contractor shall provide a minimum 48 hours notice to MRL in advance of when flagging services are required.

- D. Flagging services will be performed by qualified railroad flaggers provided by MRL at the current rate. The cost per hour for one Flagger is based on a standard 8 hour day, with time and one-half or double time for overtime, rest days, and holidays. The estimated cost for each flagger includes vacation allowance, paid holidays, Railway and unemployment insurance, public liability and property damage insurance, health and welfare benefits, vehicle, transportation, meals, lodging, radio, equipment, supervision and other costs incidental to performing flagging services.

## 1.8 GENERAL SAFETY REQUIREMENTS

- A. Prior to the start of all projects, ensure all employees of the Contractor, subcontractors, agents, and invitees receive Safety Orientation from the Contractor's Safety Officer or a qualified MRL representative. The Contractor's Safety Officer is to review MRL safety guidelines to familiarize their employees with safety issues that exist when working in a railroad environment. This should be reviewed at least weekly, and with any new employee working on MRL property. The Contractor's Supervisor and/or Safety Officer are responsible for instructing employees regarding the MRL's Safety guidelines and ensuring compliance with these guidelines.
- B. No employee of the Contractor, its subcontractors, agents or invitees may enter MRL Property without first having completed Railway's Engineering Contractor Safety Orientation, found on the web site [www.contractororientation.com](http://www.contractororientation.com). The Contractor must ensure that each of its employees, subcontractors, agents or invitees completes MRL's Engineering Contractor Safety Orientation through internet sessions before any work is performed on the Project. Additionally, the Contractor must ensure that each and every one of its employees, subcontractors, agents or invitees possesses a card certifying completion of the Railway Contractor Safety Orientation before entering Railway Property. The Contractor is responsible for the cost of the Railway Contractor Safety Orientation. The Contractor must renew the Railway Contractor Safety Orientation annually. Further clarification can be found on the web site or from the MRL's Representative.
- C. Contractor must comply with all of the Personal Protective Equipment requirements of the Railroad and as required by State and Federal regulations.
- D. Before beginning any task on MRL property, conduct a complete job safety briefing with all individuals involved with the task, and again if the task changes. If the task is within 25-feet of any track, include MRL's flagger and the procedures to be used to protect employees, subcontractors, agents, or invitees from moving any equipment adjacent to or across any railroad tracks.

- E. Immediately report damage to MRL property, or hazards noticed on passing trains, to the MRL's representative. Vehicle or machines which may come in contact with a track, signal equipment, or structure (bridge) could result in a train derailment. Report these by the quickest means possible to the MRL representative. Local emergency numbers are to be obtained from the MRL representative prior to the start of any work. Post these numbers at the job site.
- A. Perform the work to minimize impact to the existing railroad property. Report any damage to the Engineer, and repair any damage at no cost to the owner.

**PART 2: PRODUCTS – NOT USED**

**PART 3: EXECUTION**

**3.1 INTERFERENCE WITH RAILROAD OPERATIONS**

- E. Perform work on railroad right-of-way without interfering with the movements of trains or traffic on railway property. Do not cross the railway right-of-way or tracks except at temporary or existing, open public grade crossings, and as approved by MRL.
- F. The Contractor shall so arrange and conduct his work that there will be no interference with railroad operations, including train, signal, telephone and telegraphic services, or damage to the property of MRL or to the poles, wire, and other facilities of tenants on the rights-of-way of the Railroad Company. Wherever work is liable to affect the operations or safety of trains, the method of doing such work shall first be submitted to the Railroad Engineer for approval, but such approval shall not relieve the Contractor from liability.
- G. Should conditions arising from or in connection with the work, require that immediate and unusual provisions be made to protect train operations and property of MRL, it shall be a part of the required services by the Contractor to make such provisions and if, in the judgement of MRL such provisions is insufficient, MRL or the Engineer, may at the expense of the Contractor, require or provide such provisions as may be deemed necessary.
- H. The Contractor will not be permitted to provide less than 15-feet of horizontal temporary clearance to any construction falsework or equipment, measured from the centerline of the nearest track, during construction of the proposed retaining walls at the MRL Bridge 113.1.

**3.2 DAMAGES**

- A. The Contractor shall assume all liability for any and all damages to his work, employees, servants, equipment and materials caused by railroad traffic.

- B. Any cost incurred by MRL for repairing damages to its property or to property of its tenants, caused by or resulting from the operations of the Contractor, shall be paid directly to MRL by the Contractor.

### 3.3 STORAGE OF MATERIALS

- A. Materials and equipment shall not be stored where they will interfere with railroad operations, nor on the right-of-way of MRL without first having obtained permission from MRL, and such permission will be with the understanding that MRL will not be liable for damage to such material and equipment from any cause and that MRL may move or require the Contractor to move, at the Contractor's expense, such material and equipment.

### 3.4 TEMPORARY RAILROAD GRADE CROSSINGS

- A. The Owner has entered into an agreement and made arrangements with MRL for use of the property. Construct access roads in accordance with the Plans, these provisions and the Railroad Agreement.
- B. The Contractor shall construct the road and approaches in accordance with the Plans and to the satisfaction of the Engineer and MRL. Construct the temporary crossing up to the railroad portion of the work such that it does not interrupt existing drainage patterns
- C. MRL will provide materials, including the railroad track crossing material and perform all work within two feet of the rail.
- D. The temporary roadway must be removed upon completion of the project. The Contractor shall restore the property including any drainage ditches. Removal of planking or other items within 2ft of the rail will be performed by MRL.
- E. The Contractor will need to have a railroad flagman on site for construction or any work activities that are located within 25-feet from the centerline of the nearest track or have the potential to foul this zone.
- F. The Contractor will need to have a railroad flagman on site during any use of the temporary crossing. The crossings must be physically barricaded during times that it is not required for use and a flagger is not present.

### 3.5 COMPLETION AND ACCEPTANCE OF WORK

- A. Upon completion of the work, the Contractor shall remove from within the limits of the railroad right of way all machinery, equipment, surplus materials, rubbish or temporary buildings of the Contractor, and leave said rights-of-way in a neat and orderly condition. After the final inspection has been made and work found to be completed in a satisfactory manner acceptable to the Engineer and MRL, the

Engineer will be notified of MRL's acceptance in writing within ten (10) days or as soon thereafter as practicable.

**PART 4: MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. Consider all costs associated with this item incidental to the Temporary Construction Access Road bid item.

**END OF SECTION**

## SECTION 02110

### GEOTEXTILES

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work consists of furnishing, and placing a geotextile as a subsurface drainage fabric permeable separator between dissimilar materials (such as between subgrade, sub-base/base, and riprap), stabilization fabric, temporary and/or permanent erosion control measures or as waterproofing/stress releasing membrane within pavement structures.

##### 1.2 REFERENCES

- A. The current publications listed below form part of this specification.

- B. ASTM Standards

D123	Standard Terminology Relating to Textiles
D276	Test Methods for Identification of Fibers in Textiles
D4354	Practice for Sampling of Geosynthetics for Testing
D4632	Breaking; Load and Elongation of Geotextiles (Grab Method)
D4533	Trapezoid Tearing, Strength of Geotextiles
D3786	Hydraulic Bursting, Strength of Knitted Goods and Nonwoven Fabrics Diaphragm Bursting Strength Tester Methods
D4833	Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
D4491	Water Permeability of Geotextiles by Permittivity
D4751	Determining, Apparent Opening, Size of a Geotextile
D4354	Sampling, of Geotextiles for Testing
D4759	Determining, the Specification Conformance of Geosynthetics
D276	Identification of Fibers in Textiles
D4355	Deterioration of Geotextiles from exposure to ultraviolet light and water (Xenon-arc type apparatus)
D4873	Guide for Identification, Storage and Handling of Geotextiles
D5141	Test Method for Determining Filter Efficiency and Flow rate for Silt Fence Application of a Geotextile Using Site Specific Soils
D5261	Test Methods for Measuring Mass per Unit Area of Geotextiles
D422&D1140	Particle Size Analysis of Soils
D4318	Determining the Plastic Limit and Plasticity Index of Soils



D698                      The Moisture-Density of Soils Using a 2.5kg (5.5-lb) Rammer and a 305 mm (12-in.) drop

C.      AASHTO Specification - M288 Geotextile Specifications for Highway Applications

1.          Augmenting and prevailing over this specification section.

**PART 2:      PRODUCTS**

2.1      PHYSICAL AND CHEMICAL REQUIREMENTS

- A.      Assure that fibers used in the manufacture of geotextiles, and the threads used in joining geotextiles by sewing, consist of long-chain synthetic polymers, composed of at least 95% by weight polyolefins or polyesters. They must be formed into a network so the filaments on yarns retain dimensional stability relative to each other, including selvages. Furnish materials meeting the physical requirements for the indicated application as described by the corresponding table(s) of properties in AASHTO M288, Geotextiles Specifications for Highway Applications.

2.2      CERTIFICATION

- A.      Assure the manufacturer furnishes the purchaser a certificate stating: the name of the manufacturer, the chemical composition of the filaments or yards, and other information fully describing the geotextile. The manufacturer must include in the certificate, a guarantee stating that the geotextile furnished meets specifications. The certificate must be attested to by a person having a legal authority to bind the company. Mismatching, or misrepresentation by the manufacturer is reason to reject the geotextile under these specifications. Notice sent to the manufacturer by the purchaser regarding rejection of, will be considered to be notice to all wholesalers, jobbers, distributors, agents and other intermediaries handling the manufacturer's product.
- B.      Label the fabric and its container with the manufacturer's name and fabric type or trade name, lot number and quantity.

2.3      SHIPMENT AND STORAGE

- A.      During shipment and storage, protect the fabric from direct sunlight, ultra-violet rays, temperatures exceeding 160°F (71°C), mud, dust and debris. Keep the fabrics in the manufacturer's wrapping until just before use. Include with each shipping, a document, a certification showing that the geotextile meets the

manufacturer's certificate and a guarantee that has been previously filed with the purchaser.

### **PART 3: EXECUTION**

#### **3.1 GENERAL**

- A. Where placing geotextiles on native ground, cut the trees and shrubs flush with the ground surface. Do not remove the topsoil and vegetation mat. Remove all sharp objects and large rocks. Fill depressions or holes with a suitable material to provide a firm foundation.
- B. Replace or repair all geotextile that is torn, punctured, or muddy. Remove the damaged area and place a patch of the same type of geotextile overlapping 3 feet, in all directions, (0.9m) beyond the damaged area.

#### **3.2 DRAINAGE, SEPARATION AND STABILIZATION APPLICATIONS**

- A. Shape the subgrade to a smooth surface and to cross section required. Shape slopes to gradually transition into slope adjustments without noticeable breaks. At the ends of cuts, the intersection of cuts, and embankments, adjust slopes in the horizontal and vertical planes to blend into each other or into the natural ground.
- B. Remove all material larger than 6 inches (15 cm) within the top 6 inches (15 cm) of the roadbed. Remove unsuitable material from the roadbed and replace with suitable material. Finish the roadbed and ditches to the required elevation and cross-section.
- C. Place the geotextile smooth and free of tension, stress, or wrinkles. Fold and cut the geotextile to conform to curves. Overlap in the direction of construction. Overlap the geotextile a minimum of 2 feet (0.6m) at the ends and sides of adjoining sheets or sew the geotextiles joints according to the manufacturer's recommendations. Do not place longitudinal overlaps below anticipated wheel loads. Hold the geotextile in place with pins, staples, or piles of cover material.
- D. End dump the cover material onto the geotextile from the edge of the geotextile or from previously placed cover material. Do not operate equipment directly on the geotextile. Spread the end-dumped pile of cover material maintaining a minimum lift thickness of 10 inches (250 mm). Compact the cover material with rubber-tired or nonvibratory smooth drum rollers. Avoid sudden stops, starts, or turns of the construction equipment. Fill all ruts from construction equipment with additional cover material. Do not regrade ruts with placement equipment.

- E. Place subsequent lifts of cover material in the same manner as the initial lift. Vibratory compactors may be used for compacting subsequent lifts. If foundation failures occur, repair the damaged areas and revert to the use of nonvibratory compaction equipment.

### 3.3 TEMPORARY AND PERMANENT EROSION CONTROL APPLICATIONS

- A. Place and anchor the geotextile on the approved smooth-graded surface. For slope protection, place the long dimension of the geotextile down the slope. For stream bank protection, place the long dimension of the geotextile parallel to the centerline of the channel.
- B. Overlap the geotextile a minimum of 12 inches (300 mm) at the ends and sides of adjoining sheets or sew the geotextile joints according to the manufacturer's recommendations. Overlap the uphill or upstream sheet over the downhill or downstream sheet. Offset end joints of adjacent sheets a minimum of 5 feet (1.5m). Pins may be used to hold the geotextile sheets in place. Space pins along the overlaps at approximately 3 foot (1m) centers.
- C. Place aggregate, slope protection, or riprap on the geotextile starting at the toe of the slope and proceed upward. Place riprap onto the geotextile from a height of less than 12 inches (300 mm). Place slope protection rock or aggregate backfill onto the geotextile from a height less than 3 feet (0.9m). In underwater applications, place the geotextile and cover material in the same day.

### 3.4 PAVEMENT APPLICATIONS

- A. Use SS-1 crack filler meeting the applicable section for crack filler for surface preparation of cracks between 1/8 and 1/4 inch wide. Fill cracks exceeding 1/4' inch (6 mm) width with an asphalt emulsion slurry consisting of 20 percent by volume of SS-1, 2 percent by volume Portland cement and the remaining portion fine sand.
- B. Use distributors for spraying a Performance Graded (PG) Asphaltic Binder meeting the specifications for the asphalt cement being used in the asphalt concrete overlay.
- C. Place fabric using manufacturer recommended equipment.
- D. Handle and place all fabric following the manufacturer's recommendations.
- E. Clean pavement to receive fabric of dirt, water and vegetation. Clean all cracks between 1/8-inch (3mm) and 1/4 (6mm) wide and fill flush to the surface with SS-1 bituminous material. Top with sand. Repair larger cracks or holes using the asphalt emulsion slurry. Pour the mixture into the cracks until full. Refill with slurry, the following day, any cracks which are not completely filled initially. When a leveling course is required, place it before installing the fabric. Areas to be covered with a leveling course do not require surface preparations for cracks

unless the leveling courses will be less than 0.3 foot (10cm).

- F. Uniformly apply the asphaltic binder at the rate determined by the Engineer. The quantity will vary with pavement porosity. Take care to place sufficient binder to satisfy the fabric and make the membrane impervious to water without causing a slippage plane. The applications rate are typically 0.25 to 0.30 gallons per square yard. Apply binder using a distributor.
- G. Heat the asphalt binder high enough to permit a uniform spray pattern. Ensure air temperature is at least 50EF and rising before applying binder and fabric.
- H. Place the paving geotextile onto asphalt sealant with minimal wrinkling. Slit, lay flat and tack all wrinkles or folds higher than 1 inch (25 mm). Broom and/or roll the paving geotextile to maximize fabric contact with the pavement surface.
- I. At geotextile joints, overlap the geotextile 1 to 3 inches (25 to 75 mm) to ensure full closure. Overlap transverse joints in the direction of paving to prevent edge pickup by the paver. Apply additional asphalt sealant to paving geotextile overlaps to ensure proper bonding of the double fabric layer.
- J. If asphalt sealant bleeds through the fabric, treat the affected areas with blotter. Minimize traffic on the geotextile. If circumstances require traffic on the fabric, apply blotter and place “slippery when wet” signs.
- K. Broom the excess blotter from the geotextile surfaces before placing the overlay. Repair all damaged fabric before placing overlay. Apply a light tack coat before placing the overlay. To avoid damaging the geotextile, do not turn equipment on the geotextile.
- L. Place a hot asphalt concrete overlay within 48 hours after placing the paving geotextile. Limit the lay-down temperature of the mix to a maximum of 325EF (163EC) except when the paving geotextile is composed of polypropylene fibers, limit the lay-down temperature of the mix to a maximum of 300EF (149EC).

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 GENERAL**

- A. Only the geotextiles used in the construction of the trail will be measured by the square yard on a plane parallel to the ground surface, excluding overlaps. The accepted quantities measured as provided above, will be paid at the contract price per unit of measurement for the pay items that is shown in the bid schedule.
- B. Payment indicated to include complete compensation for all labor, equipment, materials and incidentals required for the completion of the work.

**END OF SECTION**

## **SECTION 02112**

### **REMOVAL OF EXISTING PAVEMENT AND CONCRETE DEBRIS**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. The work consists of removing and disposing of existing pavement and miscellaneous concrete debris designated for removal in the Drawings.

#### **PART 2: PRODUCTS - NOT USED**

#### **PART 3: EXECUTION**

##### **3.1 GENERAL**

- A. Dispose of all existing pavement and concrete debris specified for removal in the Drawings or directed by the Engineer. Exercise care in such removal to assure that remaining nearby facilities and/or structures are not disturbed. Restore to original condition any such existing facilities or structures damaged by construction activities.
- B. Cut, remove and dispose of designated existing pavement to the lines indicated on the Drawings, or directed by the Engineer. Make straight and approximately vertical cuts of edges along which new pavement is to be placed.
- C. Remove and dispose of existing concrete which interferes with construction of street improvements or which do not match new grade as shown on the contract documents, or as directed by the Engineer. Remove such

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 ASPHALTIC PAVEMENT AND CONCRETE REMOVAL**

- A. Any miscellaneous asphaltic pavement and concrete removal is not measured. The cost of removal is incidental and included in the unit price or lump sum price bid for various items of the work.

**END OF SECTION**

## SECTION 02114

### RELOCATING, INSTALLING, OR REMOVING UTILITY POLES, STREET SIGNS, INFORMATIONAL SIGNS, BENCHES AND FENCES

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This item consists of relocating, installing, or removing utility poles, signs, benches, bollards, and fences as shown in the contract documents.

#### PART 2: PRODUCTS

##### 2.1 Chain Link Fence

- A. Furnish fabric, posts, rails, ties, bands, bars, rods and other fittings, and hardware conforming to AASHTO M181.

##### 2.2 Signs

- A. Posts. Furnish wood posts that are straight, smooth, and without defects affecting strength, durability, or appearance. Furnish posts conforming to AASHTO M 168. Treat the posts according to Category 4A of the AWWPA Standard U1-UC4A, *Ground Contract, General Use* for waterborne preservative treatments ACA, ACZA, or CCA.
- B. Retroreflective Sheeting. Conform to ASTM D4956, including supplementary conditions.
- C. Panels. Conform to the following:
  - 1) Plywood. Furnish exterior Grade B-B high –density overlay plywood or better conforming to NIST Products Standard PS A, *Construction and Industrial Plywood*. Use 1/2 –inch thick plywood for sign panels with a facial area 4 square feet or less and the horizontal dimension no greater than the vertical dimension. Use 3/4-inch thick plywood for larger panels.
  - 2) Aluminum. Furnish panels conforming to ASTM B209, alloy 6061-T6 or 5052-H38. Fabricate temporary panels and permanent panels smaller or equal to 30 by 30 inches from 0.080-inch thick aluminum sheets. Fabricate larger permanent panels from 0.125-inch thick aluminum sheets

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STREET SIGNS, INFORMATION SIGNS, BENCHES AND FENCES

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- D. Hardware. Furnish galvanized steel or aluminum alloy lag screws, washers, clip angles, wood screws, shear plates, U-bolts, clamps, bolts, nuts, and other fasteners.  
Galvanize steel hardware according to AASHTO M 232.  
For aluminum alloy bolts, nuts, and washers, conform to American standard heavy hexagon ANSI B18.2. For threads, conform to American standard coarse series, Class 2 fit, ANSI specification B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).  
For neoprene or nylon washers, furnish 1/8 inch thick by 1-inch minimum outside diameter with maximum allowable applied torque 480 inch-pounds.

## 2.2 Bollards

- A. Provide cast iron cylindrical bollard that is 48" high x 8" diameter with a rounded top, meeting the requirements of ASTM A513 Type 1. Provide a heavy duty steel sleeve with locking cover plate meeting the requirements of ASTM A513 Type 5. The bollards must be completely removable from the sleeve and provide a flush surface when the lid drops down
- B. Prime all steel surfaces with rust and corrosion resistant, zinc rich primer with 5,000 hour salt spray performance. Finish the bollard to be powder coated yellow that meets decorative and functional requirements for gloss retention, physical properties, chemical resistance, and weatherability.
- C. Furnish concrete meeting the requirements of Section 03310, STRUCTURAL CONCRETE.
- D. Provide schedule 40 PVC pipe for the drain lines.
- E. Provide deformed reinforcing steel meeting the requirements of Section 03210 REINFORCING STEEL.

## PART 3: EXECUTION

### 3.1 UTILITY POLES

- F. Coordinate with affected utility companies that need to move power, street light, and utility poles, unless they are designated in the contract documents to be removed or relocated by the Contractor.
- G. When relocating or removing power poles, street light poles and utility poles, comply with any applicable requirements of the contract documents.

### 3.2 STREET AND TRAFFIC CONTROL SIGNS

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STREET SIGNS, AND FENCES  
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- A. Remove and reinstall all street, stop and other traffic control/direction signs designated to be relocated by the Contractor as shown in the contract documents, or as designated by the Engineer. Include removing, temporarily installing, storing, and permanently installing the signs.
- B. Install all street, stop, traffic control, and other signs as shown in the contract documents or as designated by the Engineer.
- C. The locations shown in the contract documents for street lights, street signs, power poles, utility poles are approximate only. The specific locations are to be designated by the Engineer.
- D. Relocate all signs within the staked grading limits whose existing locations do not conform to final plan locations. Also relocate signs outside the staked grading limits to conform to final plan locations.
- E. Preserve all street, stop and other traffic and direction signs that are to remain in place. Should any such signs be moved for the contractor's convenience, permanently reinstall the signs after construction the road or parking lot improvements are complete. Assume responsibility for any damage to such signs. No extra compensation will be allowed for preserving, removing or replacing stop and traffic control and direction signs designated to remain in place, since this work is considered incidental to the contract unit prices for the various items of the contract.
- F. Where stop signs and traffic direction or control signs are temporarily removed, but are needed for traffic reasons during construction, temporarily install a similar stop sign or traffic direction sign in locations acceptable to the Engineer. Assure that the temporary signs remain in place until the permanent stop or traffic control signs are in place.
- G. Do not install street signs temporarily.
- H. Store signs which are not used for temporary installation.
- I. Set all permanent signs according to the detail as shown on the drawings. Replace all signs which have been damaged after removal with new signs.
- J. Install sign systems at locations shown on the drawings or as directed in the field by the Engineer. Sign types are included on the drawings. Assure that all sign sizes and locations conform to the latest issue of the Manual on Uniform Traffic



- K. Remove all signs designated for removal so not to damage the signs. Salvage and deliver all such damaged signs to the Engineer.

### 3.3 BENCHES

- A. Construct bench foundation pad and placement of anchor bolts per instructions and specifications where shown on the drawings. Benches will be provided by the Owner. Contractor is responsible for furnishing all labor, materials, and hardware for the successful installation of the benches. Refer to Section 03310, Structural Concrete, for specifications on construction of the concrete bench foundation pads.

### 3.4 FENCES

- A. Remove and Relocate - Fences within the staked construction limits shall be carefully removed and stored at a location where they will not be damaged. Before removing fencing on any property, contact the land owner to coordinate the work. Relocate the fence to the new location as staked in the field or as directed by the Engineer. Provide all materials, hardware, and labor necessary to relocate the fence. In some cases it may be necessary to replace certain fence posts. Replace posts as directed by the Engineer with posts of like material and color. Obtain approval from the Engineer before installing contractor furnished posts.
- B. Remove and Replace - Fences within the staked construction limits shall be carefully removed and stored at a location where they will not be damaged. Before removing fencing on any property, contact the land owner to coordinate the work. Replace the fence in the same location from where it was removed or in a location as directed by the Engineer. Provide all materials, hardware, and labor necessary to reinstall the fence. In some cases it may be necessary to replace certain fence posts. Replace posts as directed by the Engineer with posts of like material and color. Obtain approval from the Engineer before installing contractor furnished posts.
- C. Installation – Install the fence to the dimensions called for in the contract documents.
  - 1) Top Rail – Install top rails through the loop caps of the line posts, forming a continuous brace from end-to-end of each stretch of fence. Join lengths of top rail with sleeve type couplings. Securely fasten top rails to terminal

- posts by pressed steel fittings or other appropriate means.
- 2) Bottom Rail - Install bottom rails between posts. Securely fasten bottom rails to terminal posts by pressed steel fittings or other appropriate means.
- 3) Fence Fabric – Place fence fabric on the side of the post facing the Park unless otherwise specified by the Engineer.

### 3.5 INFORMATIONAL SIGNS

- A. Construct informational sign foundation pad and placement of anchor bolts per instructions and specifications where shown on the drawings. Informational content will be provided by the Owner. Contractor is responsible for furnishing all labor, materials, and hardware for the successful installation of the informational signs.

### 3.6 BOLLARDS

- A. Install bollard following manufacturer's installation instructions.
- B. Protect bollards against damage. Damaged, cracked, chipped, deformed or marred bollards will not be accepted. Field touch-up minor imperfections in accordance with manufacturer's instructions.
- C. Install schedule 40 PVC drain line, reinforcing steel, and the heavy duty steel sleeve prior to placing concrete. Grade drain line at a minimum -1% slope till it daylight. Orient the steel sleeves as shown in the contract documents, to be vertical. Place and finish concrete as shown in the contract documents.

## **PART 4: MEASUREMENT AND PAYMENT**

### **4.1 GENERAL**

- A. Measurement and payment for the following items is made only if listed as separate pay items in the contract documents. If not so listed separately, these items will not be paid for separately but are to be included as incidental to the other pay items of the contract documents.
- B. Payment indicated to include complete compensation for all labor, equipment, materials and incidentals required for the completion of the work.

### **4.2 STREET AND TRAFFIC CONTROL SIGNS**

- A. Reinstall all street, stop and traffic control or direction signs removed for the Contractor's convenience at no cost.
- B. Street, stop, and traffic control or direction signs designated for installation, relocation or removal shall be measured and paid for by the number of street, stop and traffic control or direction signs relocated or removed at the unit price bid for the item listed below, which price and payment constitute full compensation for all materials, excavation, temporary and/or permanent installation, forming and curing of concrete, equipment, tools, labor, and incidentals necessary to complete the item. If two or more signs exist on one post, they are defined as one sign for payment purposes.
- C. When a sign system is measured by the each, measure each sign system as one sign regardless of the number of sign panels or supports. A sign system includes the supports.

### **4.3 BENCHES AND INFORMATIONAL SIGNS**

- A. Benches and informational signs and concrete foundations shall be measured and paid for by the number of units installed, complete in place, at the contract unit price bid which price and payment shall constitute full compensation for all excavation and backfill, furnishing and installing all materials required (concrete, anchor bolts, rebar, etc.), compaction, labor, tools and incidentals necessary to complete the item.

#### 4.4 FENCES

- A. Reinstall existing fences removed for the Contractor's convenience at no cost.
- B. Fences designated for relocation shall be measured and paid for by the lineal foot relocated at the unit price bid for the item listed below, which price and payment constitutes full compensation for all materials, excavation, temporary and/or permanent installation, forming and curing of concrete, equipment, tools, labor, and incidentals necessary to complete the item. New fence posts required at the direction of the Engineer will not be paid for separately but will be included in the unit price bid for the item listed below.
- C. Installation of new fence shall be measured and paid for by the lineal foot installed at the unit price bid for the item listed below, which price and payment constitutes full compensation for all materials, excavation, installation, forming and curing of concrete, equipment, tools, labor, and incidentals necessary to complete the item.

#### 4.5 BOLLARDS

- A. Bollards will be measured and paid for by the number of units installed, complete in place, at the contract unit price bid which price and payment shall constitute full compensation for all excavation and backfill, furnishing and installing all materials required (concrete, anchor bolts, rebar, etc.), compaction, labor, tools and incidentals necessary to complete the item.

### **END OF SECTION**

## SECTION 02221

### TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work is the excavation, trenching and backfilling for pipelines and appurtenances. It includes all clearing, grubbing, site preparation, removal and disposal of debris from the excavation, handling and storing materials for fill and backfill, all bracing, shoring and trench protection, construction dewatering, all backfill, subgrade preparation, final grading, site dressing and cleanup.

##### 1.2 REFERENCES

- A. The current publications listed below form a part of this specification.

AASHTO T99	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
ASTM D698	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
AASHTO T191 (ASTM D1556)	Density of Soil In-Place by the Sand-Cone Method
AASHTO T23 8 (ASTM D2922)	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
AASHTO T239 (ASTM D3017)	Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
AASHTO T11 (ASTM C1 17)	Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90 ASTM D4318	Determining the Plastic Limit and Plasticity Index of Soils Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

### 1.3 TESTING

#### A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements in Section 01400, Contractor Quality Control and Owner Quality Assurance.
2. In-place field density tests for quality assurance are at Contractor expense meeting AASHTO T191 (ASTM D1556), Sand Cone Method; or by AASHTO T310 (ASTM D6938) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the Engineer's discretion.
3. Re-testing failing areas is at the expense of the Contractor.
4. At the direction of the Engineer, provide necessary equipment and labor to excavate and replace materials for test holes up to 5 feet deep into the compacted backfill to allow testing below the surface of any layers covered without inspection and approval by the Engineer.

#### B. Laboratory Maximum Density and Optimum Moisture

1. Quality assurance tests will be made by the independent testing agency for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content according to AASHTO T-99 or ASTM D698.

#### C. Material Submittals

1. Submit to the Engineer material quality test results including Type 1 Bedding gradation and plasticity index; and Type 2 Bedding gradation.
2. Submit to the independent testing agency samples of on-site and off-site borrow soils for laboratory moisture-density relationship testing by the independent testing agency.
3. If applicable, submit a blasting plan to the Engineer.

## PART 2: PRODUCTS

### 2.1 PIPE BEDDING MATERIALS

#### A. TYPE 1 PIPE BEDDING

- Unless otherwise specified, pipe bedding material shall be placed in a thickness equal to  $\frac{1}{4}$  X pipe O.D. but not less than four (4) inches below the pipe, through six (6) inches above the pipe. Material shall be clean non-cohesive natural, unwashed gravel, sand or crushed hard stone graded as follows with a plasticity index of six (6) or less as determined by AASHTO testing methods T89 and T90. Native trench material shall not be used for pipe bedding material without approval of the Engineer. Where rock is encountered the bedding requirement will be increased to six (6) inches below and one (1) foot above the pipe.

Normal Type 1 Bedding		Wet Condition Type 1 Bedding	
Sieve Size	Percent Passing	Sieve Size	Percent Passing
1-inch	100%	1-inch	100%
#4	40-70%	#4	40-100%
#200	10% or less	#200	0%

- When wet or unstable conditions are encountered, Contractor shall use alternate wet condition type 1 bedding that shall be free draining and non-plastic.

#### B. SELECT TYPE 1 BEDDING

- Select Type 1 Bedding includes the material placed from the springline of the pipe to 6 inches (15cm) over the pipe.
- Select Type 1 Bedding shall consist of soil, sand or fine gravel, free from clods, lumps of frozen material, or rock exceeding 1-1/2 inches (38mm) in its greatest dimension.
- Excavated trench material may be screened or sorted for use as backfill subject to approval of the Engineer.
- Where trench excavation encounters wet or unstable material, Select Type 1 Bedding must be free draining and non-plastic.

#### C. TYPE 2 PIPE BEDDING

- Type 2 Pipe Bedding is used as directed by the Engineer to replace unsuitable material encountered in the trench bottom.

2. Place Type 2 Pipe Bedding from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.
3. Type 2 Bedding shall consist of granular material meeting the following gradation.

<u>Sieve Opening</u>	<u>% Passing</u>
3 Inch	100
No. 4	0 - 25
No. 8	0 - 10

#### D. SEPARATION GEOTEXTILE

1. The plans may require, or the engineer may direct, the use of non-woven geotextile fabric intended to provide materials separation. The fabric will wrap all or part of the Type 1 Pipe Bedding and Select Type 1 Pipe Bedding to prevent materials migrating into the trench bottom and trench walls as shown on the plans or as directed by the engineer. The fabric shall be AASHTO M288 Class 1, 2, or 3 as specified or determined by the Engineer and shall fully comply with MPWSS Section 2110.

### 2.2 TRENCH BACKFILL MATERIALS

#### A. Materials from Trench Excavation

1. Backfill material obtained from trench excavations must be free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious materials. Backfill materials and placement are further described in the Execution Section of this specification.

#### B. Imported Backfill Material

1. Imported backfill material is from borrow source(s) outside the project limits and is used when, in the opinion of the Engineer, an adequate volume of suitable backfill material is not available within the project limits. Imported Backfill Materials must comply with the requirements of Section 2.2.A, MATERIALS FROM TRENCH EXCAVATION.

### 2.3 FLOWABLE FILL

- A. If used, Flowable Fill is to meet the requirements of Montana Public Works Standard Specifications Section 2225, Flowable Fill.

### 2.4 DETECTABLE BURIED WARNING TAPE



- A. Detectable buried warning tape is to have a minimum 6 inch (15cm) width and 5 mil (0.12mm) thickness and a solid aluminum core running the full length and width of the tape enclosed in a color coded inert plastic jacket, impervious to alkalis, chemical reagents and solvents in the soil. The tape is to meet APWA/ULCC Color Code requirements and is to have a maximum 36 inch (90cm) imprint.

### **PART 3: EXECUTION**

#### **3.1 PROTECTION OF EXISTING PROPERTIES**

##### **A. General**

1. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, and fences. Restore or replace all disturbed or damaged facilities to its original condition at Contractor's expense.
2. Contact utility owners using the Montana One Call System in accordance with Section 01041, PROJECT COORDINATION, Paragraph 1.2.B., for utility locates before starting work. Protect the utilities exposed during the work and prevent damaging underground utilities adjacent to excavations. Immediately notify the utility owner of any construction damage. Repairs of damage to marked utilities are at the expense of the Contractor.
3. Cut and replace existing service lines interfering with trenching operations only with the engineer's permission and at the contractor's expense. Show all repaired and/or adjusted water and sewer lines on the As-Built Plans.
4. Protect existing water and sewer mains and water and sewer services from freezing at all times during construction.

##### **B. Privately Owned Utilities**

1. If any existing private utility interferes with the work in either alignment or grade, and has to be moved, the work will be performed by the appropriate utility owner, unless otherwise specified in the contract documents. Such private utilities may include gas mains, underground electrical and telephone cables, telephone poles, light poles, etc.
2. If, however, such private utility relocation is performed by the Contractor, and the relocation is not a separate payment item, payment will be made under the Section 02221 conditions covering such changes.
3. Such payment will be made only if the work is determined by the Engineer to be a change from the original contract work scope.

C. Existing Structures

1. Prevent damage to existing buildings or structures in the work area. Repair all construction related damage to the satisfaction of the Owner.
2. Where existing structures exist in the right of way, obtain permission from the Owner before the removal of such structures. Remove structures in a manner that will minimize damage to the structure.

D. Existing Overhead Utilities

1. Use extreme caution to avoid conflict, contact or damage to overhead utilities during the work.

E. Exploratory Excavation

1. The location of existing buried public utilities may need to be verified by exploratory excavation before construction.
2. Exercise care to prevent damaging all utilities and repair any utility damage caused by exploratory excavation.

F. Pavement Removal and Stripping

1. Where trench excavation or appurtenant structure excavation requires removing curb and gutter, concrete sidewalks, asphalt concrete pavement, or Portland cement concrete pavement, cut the concrete or pavement in a straight line parallel to the excavations edge using a spade-bitted air hammer, concrete saw or other suitable equipment to produce a straight, square and clean break. Re-cut edges broken during construction, before concrete or paving operations.
2. For trenches passing through existing pavement, cut the pavement along a neat vertical line at least 12 inches (30cm) from the trench edge. Where the neat line cut is less than 3 feet (0.9m) from the edge of the existing pavement, remove and replace the entire pavement section between trench and edge of pavement.
3. Dispose of the asphalt concrete and/or Portland cement concrete debris off-site according to applicable state and local regulations.

G. When excavating across existing gravel streets or other developed surfaces, remove the surfacing material full depth and stockpile for inclusion as trench backfill or legally dispose of the surfacing material.

- H. When excavating across cultivated or sodded areas, remove topsoil full depth or to a maximum 12 inch (30cm) depth, whichever is less, and stockpile for possible project use.
- I. Re-sod or reseed, as specified in the contract documents, all established lawn areas cut by trenching or damaged during the construction, in accordance with Section 2910, and/or 2920, to the satisfaction of the Engineer.

### 3.2 Clearing and Grubbing

- A. This work consists of clearing and grubbing as well as topsoil removal for construction of the project. Do not damage vegetation designated to remain. If vegetation designated to remain is damaged or destroyed, repair or replace the vegetation in an acceptable manner.
  - a. Cut trees so they fall within the clearing limits. In areas of cut slopes, cut stumps flush with or below the final groundline. Limb the trees, and stack the logs in a location approved by the Engineer.
  - b. Grub all areas to be excavated and all embankment areas.

### 3.3 MAINTENANCE OF FLOWS

- A. Maintain the flow of sewers, drains and water courses encountered during construction. Restore culverts, ditches, fences, crosswalks and structures disturbed by construction to their original condition upon completion of the work.

### 3.4 TRENCH EXCAVATION

- A. General
  - 1. Meet current OSHA Safety and Health Standards for all excavation, trenching, shoring, and related work.
  - 2. Excavate at the specified locations for pipeline installations and appurtenant structures.
  - 3. Crossings under sidewalks or curbs may be made by tunneling, if approved by the Engineer. If a portion of a sidewalk or curb is removed, use a concrete saw to remove the section at the nearest joint, compact the backfill as specified, and replace the removed section with new concrete sidewalk or curb.
  - 4. During excavation, stockpile backfill materials away from the trench banks to assure trench wall stability. Stockpile excavated materials on only one side of the trench without obstructing existing fire hydrants,

valves, manholes and other appurtenances. Assure surface drainage of adjoining areas is unobstructed.

5. Remove and dispose of all excess or unsuitable excavated materials.
6. Prevent surface water from flowing into excavations. Promptly remove all water accumulating in trench excavations. Do not permit water to accumulate in any open trench. Remove and re-lay all pipe out of alignment or grade caused by trench flooding.
7. Grade the trench bottoms to the specified lines and grades. Assure bedding material provides uniform bearing and support for each pipe section along its entire length. Excavate for bell and joints after the trench bedding is graded, limiting the excavation to the required length, depth and width for making the particular type of joint used. Backfill over-excavations with Type 2 Bedding Material or other material as directed by the Engineer.
8. No differentiation between common and rock trench excavation is made, except when listed as separate bid items on the bid proposal or bid form. Excavation includes removing and subsequent handling of all earth, gravel, bedrock or other material encountered regardless of the type, character, composition or condition of the material.
9. The use of trench digging machinery is permitted, except in places where its operation is likely to cause damage to existing structures or features, in which case hand methods are to be employed.

B. Trench Dimensions

1. Excavate to the trench dimensions specified below.
2. Width
  - a. Excavate to provide room to install and join the pipe as specified. The minimum trench width is 3'-6" (1.1m), for outside pipe diameters of 18 inches (0.5m) or less. The minimum trench width is 2'-0" (0.6m) plus the outside pipe diameter, for pipe sizes exceeding 18 inches (0.5m). Maximum trench width may be specified in the contract documents.
3. Depth
  - a. Excavate the trench as required for the invert grade or pipe bury as specified in the contract documents, plus 4 inches (10cm) for the Type 1 Pipe Bedding. If bedrock, boulders or large stones are encountered at the bottom of the trench, excavate at least 6 inches

(15cm) below the bottom of the pipe for backfilling with Type 1  
Pipe Bedding.

C. Soft or Unsuitable Trench Subgrade

1. When soft or unstable material is encountered at the trench subgrade which will not uniformly support the pipe, excavate the material to the depth directed by the Engineer and backfill to trench subgrade elevation with Type 2 Pipe Bedding.

D. Pavement Damage Cause by Equipment

1. Equip all track mounted equipment operated on pavement surfacing with pads to prevent pavement damage.
2. Restore all pavement damaged by construction to its original condition.

E. Shoring, Bracing and Sheeting

1. Provide all shoring, bracing and tight sheeting required to prevent caving and protect workers, meeting current Occupational Safety and Health Act Requirements, and to protect adjacent property and structures. The cost of this work is included in the cost for trench excavation.

F. Excavation for Appurtenances

1. Make excavations for manholes, hydrants, structures and other appurtenances of the size and depth to permit compacting of backfill on all sides to the specified density. The requirements for removing water and other applicable portions of these specifications apply to excavation for appurtenances.

### 3.5 DEWATERING

- A. Remove all ground water encountered in trench excavations. Do not place pipe, bedding or backfill materials below the groundwater elevation established by dewatering operations. The cost of dewatering operations is considered a part of the excavation cost.

### 3.6 EXCAVATION STABILITY AND SAFETY

- A. The stability of construction excavations and associated worker safety, including slope geometry and shoring/bracing considerations, are the responsibility of the Contractor. Meet current OSHA regulations. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

### 3.7 TRENCH FILLING AND BACKFILLING

#### A. General

1. Backfill all trenches as specified immediately after grade, alignment and pipe jointing has been inspected and approved by the Engineer. Conduct any pipe testing as specified in the respective water distribution, sewerage/drainage sections. Correct all defects discovered by tests prior to backfilling.

#### B. Pipe Bedding Placement

1. Type 1 Bedding.
  - a. All granular fill material beneath the pipe shall be spread and compacted to provide a uniform and continuous support beneath the pipe at all points between bell holes and pipe joints. It will be permissible to slightly disturb the finished sub grade surface by the withdrawal of pipe slings or other lifting tackle. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular fill when the pipe is jointed.
  - b. After each pipe has been graded, aligned and placed in final position on the bedding materials, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing, embedment and backfilling operations.
  - c. Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement of the pipe. Where wet or unstable material exists, assure the material is free draining and non-plastic.
2. Select Type 1 Bedding.
  - a. Place Select Type 1 Bedding material from the springline to 6 inches (15cm) over the pipe. Where wet or unstable material exists, assure the material is free draining and non-plastic.
  - b. Place in maximum lifts of 6 inches (15cm) using hand or other compaction methods without damaging or disturbing the pipe. Thoroughly compact each layer.

- c. Place backfill in equal lifts on both sides of the pipe for the full trench width. Take care to prevent migration of Select Type 1 Bedding into surrounding soils during placement and compaction.
  - 3. Type 2 Pipe Bedding.
    - a. Use Type 2 Pipe Bedding described in PRODUCTS SECTION as specified or as directed by the Engineer to replace unsuitable material encountered in the trench bottom, placing it from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.
    - b. Where wet or unstable material exists, assure the material is free draining and non-plastic.
  - 4. Separation Geotextile
    - a. Place Separation Geotextile where shown on the plans or where directed by the Engineer.
- C. Trench Backfill
  - 1. After the pipe bedding materials are placed and compacted as specified, backfill the trench. Use backfill material free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious materials. From the top of the Select Type 1 Pipe Bedding to 6 inches (15cm) below the ground surface, or to the subgrade elevation, material containing rock up to 8 inches (20cm) in the greatest dimension may be used.
  - 2. Trench backfill from the top of the pipe bedding to ground surface or to the street subgrade is separated into three classifications.
    - a. Type A Trench Backfill is compacted backfill typically used in streets or paved areas.
    - b. Type B Trench Backfill is typically used for unpaved alleys, cultivated areas, borrow pits, unimproved streets or other un-surfaced areas, and other areas where compaction is less critical.
    - c. Type C Trench Backfill is typically used in open and unimproved areas outside of the public right-of-way.
  - 3. Meet the backfill and compaction requirements for all of the backfill types described in the contract documents.
  - 4. Watering

- a. Apply uncontaminated water, when required, at the locations and in the amounts required to compact the backfill material to the specified requirements. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.
  - b. Apply water during the work to control dust and to maintain all embankment and base courses in a damp condition in accordance with these contract documents.
  - c. Water required for compacting trench backfill may be obtained from the municipal system if approved by the Owner, or from other sources.
5. Remove, replace, and re-compact backfill in trenches where settlement has occurred as directed by the Engineer at the contractor's expense.
6. Trench backfill types are designated as follows:
- a. Type A Trench Backfill. Place trench backfill in maximum 8 inch compacted lifts within 3 percent of optimum moisture content, and compact to at least 95 percent of maximum dry density determined by AASHTO T99 or by ASTM D698.
  - b. Type B Trench Backfill. Place backfill in maximum 8 inch (205mm) lifts, within 3 percent of optimum moisture content, and compact to at least 90 percent of maximum dry density, as determined by AASHTO T99 or by ASTM D698.
  - c. Type C Trench Backfill. Place and compact Type C Trench Backfill in maximum 12 inch lifts at densities equal to or greater than the densities of adjoining undisturbed soil. Mound earth over the trench top, if so directed by the Engineer.
  - d. Flowable Fill. Place flowable fill as trench backfill as shown in the contract documents or as directed by the Engineer. Flowable fill may also be used as a construction expedient, substituting for any type of trench backfill, subject to approval by the Engineer and at the expense of the Contractor.

D. Replacement of Unsuitable Backfill Material

- 1. Remove and dispose of excavated soils that are saturated, contain deleterious materials or have characteristics that, in the opinion of the Engineer, render the soils unsuitable as backfill.



2. Replace unsuitable soils with material obtained from trench excavations within the project limits at the expense of the Contractor. If suitable replacement material is not available within project limits, obtain material from an approved borrow source, to be paid under SECTION 01800 MISCELLANEOUS.
3. Place and compact all imported material according to the applicable backfill specification requirements.

E. Backfill of Appurtenances

1. Place and compact backfill for appurtenances to finished grade around manholes, inlets, valve boxes and other underground items without disturbing appurtenance alignments.
2. Meet the backfill material, placement, and compaction requirements specified for the adjoining trench.

F. Detectable Buried Warning Tape

1. The use of warning tape is optional and if used must not be relied on as the primary locating device. Provide warning tape as described in PRODUCTS Section 2.3. Bury tape a maximum 18 inches (45cm) below finish surface grade.

3.8 SURVEY MARKERS AND MONUMENTS

- A. Protect all survey markers and monuments. Protection includes marking with flagged high lath and supervising work near markers and monuments. Do not disturb monuments without prior approval from the Engineer.
- B. Replace all Contractor disturbed or destroyed survey markers or monuments, not approved during construction, using a licensed land surveyor. See Section 01050 for details on survey marker protection/disturbance.

3.9 CLEANUP

- A. As work progresses, remove debris and complete to finish grade each portion of the work. Once the work is complete, clear debris and finish the entire site to smooth, uniform slopes presenting a neat and workmanlike appearance. Remove and dispose of all rocks brought to the surface during excavation or backfilling.

3.10 TIME AND DISTANCE OF OPEN TRENCHES

- A. Perform the work so that trenches will remain open the minimum time required to accomplish the work.

- B. Do not begin trench excavating until appropriate compaction equipment is at the excavation site.
- C. The maximum permissible distance between backfilling/ compaction operations and the end of newly installed pipe is 200 feet (60m) in existing streets (and/or alleys) and 500 feet (150m) in all other areas.
- D. The maximum distance between the newly installed pipe and the excavator is to be 100 feet (30m) in existing streets (and/or alleys) and 200 feet (60m) in all other areas.
- E. For each work group consisting of a trench excavator, a pipe laying crew, and a backfilling/compacting crew, the maximum allowable open ditch at any time is 300 feet (90m).
- F. The maximum distance behind the end of the new pipe is 1,500 feet (460m) for gravel surfacing replacement, base placement or pavement replacement.
- G. Trench excavation for pipes crossing the roadway must allow for passage of at least one lane of traffic for vehicle passage at all times.

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 GENERAL**

- A. The following items constitute pay items for the work covered under this section. Payment for these items is full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.

##### **4.2 TRENCH EXCAVATION AND BACKFILL**

- A. No separate measurement and payment is made for TRENCH EXCAVATION AND BACKFILL. All costs for this item is considered to be incidental to the work being performed.
- B. The upper limit of the TRENCH EXCAVATION AND BACKFILL item is defined as the top of subgrade. Details of the various types of surface restoration are found in the contract documents.

##### **4.3 TYPE 1 AND SELECT TYPE 1 PIPE BEDDING**

- A. Include approved material for Type 1 and Select Type I Pipe Bedding in the pipe installation price. No measurement or additional payment is made for furnishing or placing Type 1 and Select Type 1 Pipe Bedding materials.

#### 4.4 TYPE 2 PIPE BEDDING

- A. Approved material for Type 2 Pipe Bedding to replace soft or unsuitable material, is measured in cubic yards (cubic meters) of material furnished, in-place, for the depth directed.
- B. Payment quantity is based upon an excavation width of 2.0 feet (0.6m) plus the outside pipe diameter with a minimum payment width of 3.5 feet (1.1 m).
- C. If Type 2 Bedding is placed without the engineer's written authorization, the Type 2 Bedding is a construction expedient solely for the contractor's convenience and no payment for Type 2 Bedding will be made.

#### 4.5 IMPORTED BACKFILL MATERIAL

- A. When satisfactory backfill material is not available within the project limits, backfill material imported from borrow sources outside the limits of the project site are measured in cubic yards of material furnished, in place (compacted), for the depth directed by the Engineer.
- B. The trench width for measurement and payment is 2.0 feet (0.6m) plus the outside pipe diameter, with a minimum payment width of 3.5 feet (1.1 m), measured between vertical planes for the depth required.
- C. Payment for imported backfill material to replace excavated material deemed unsuitable by the Engineer will be made under SECTION 01800 MISCELLANEOUS WORK at a price mutually agreed upon between the Engineer and the Contractor, per cubic yard, which includes furnishing, placing, and compacting the backfill material as specified and all other work necessary or incidental for completion of the item.
- D. No separate measurement and payment is made for this item when, in the engineer's opinion, suitable surplus material is available within the project limits, in which case all costs for this item are to be included in the unit price bid for pipe, complete in-place.
- E. Payment for Imported Backfill will be made only if the Engineer determines surplus material is not available within the project limits.

#### 4.6 EXPLORATORY EXCAVATION

- A. This item will not be measured and paid for separately unless requested by the Engineer. Exploratory excavation services requested by the Engineer will be paid for under SECTION 01800 MISCELLANEOUS WORK.

**END OF SECTION**

## SECTION 02230

### STREET EXCAVATION, BACKFILL AND COMPACTION

#### PART I: GENERAL

##### 1.1 DESCRIPTION

- A. This work is the clearing and grubbing, excavation, filling or backfilling, and subgrade preparation to the specified lines, grades and cross sections as preparation for overlying base course or other courses as shown in the contract documents. Also included are the removal and disposal of debris and excess soil, the furnishing and placement of fill materials, and compaction.

##### 1.2 REFERENCES

- A. The current publications listed below are a part of this specification.

AASHTO T99	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb. (2.5 kg) Rammer and 12-inch (305 mm) Drop
ASTM D698	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb. (2.5kg) Rammer and 12-inch (305mm) Drop
AASHTO T191 (ASTM D1556)	Density of Soil In-Place by the Sand-Cone Method
AASHTO T238 (ASTM D2922)	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
AASHTO T239 (ASTM D3017)	Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
AASHTO T11 (ASTM C117)	Materials Finer Than 75mm (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
ASTM D4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

### 1.3 DENSITY CONTROL TESTING

#### A. Field Density Testing

1. Meeting the quality control and quality assurance testing requirements in Section 01400, Contractor Quality Control and Owner Assurance.
2. In-place field density tests for quality are at Contractor expense meeting AASHTO T191 (ASTM D1556), Sand Cone Method; or AASHTO T310 (ASTM D6938) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the discretion of the Engineer.
3. Retesting of failing areas is at the expense of the Contractor.

#### B. Laboratory Maximum Density and Optimum Moisture

1. Quality assurance tests will be made by the Contractor's independent testing agency for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content under AASHTO T99 or ASTM D698.

#### C. Materials Submittals

1. Submit to the Engineer results of gradation tests for Subexcavation/Replacement below subgrade pitrun gravel/sand.
2. Submit to the Engineer upon request, samples of soils and/or aggregates that contain laboratory moisture-density relationship information.

## **PART 2: PRODUCTS**

### 2.1 ON-SITE EMBANKMENT

- A. Fill and backfill are to consist of natural soils free from organic matter, frozen material, refuse, construction debris or other man-made items. Obtain approval of the Engineer for all fill before placing and use only the fill from designated borrow areas.

### 2.2 IMPORTED BORROW MATERIALS (FOR EMBANKMENTS IN-PLACE)

- A. If required, obtain borrow soil for embankments from areas off the project site. Furnish imported borrow at Contractor expense. Obtain Engineer approval of borrow areas. Imported borrow is to meet the requirements of Section 2.1, On-Site Embankment.

## 2.3 SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE

- A. Sub-excavation consists of removing and disposing of unstable material from below planned subgrade elevation in cut sections or from below the natural ground line in embankment sections.
- B. Replacement material for subexcavations consists of either:
  - 1. Suitable materials from within the project limits if suitable material is present within the project limits, or
  - 2. Imported materials if suitable material is not present within the project limits. Where imported pitrun gravel is used, furnish replacement material meeting the following gradation requirement:

<u>Sieve Opening</u>	<u>% Passing</u>
3 Inch	100
No. 4	25 - 60
No. 200	12 Max.

## PART 3: EXECUTION

### 3.1 CLEARING AND GRUBBING

- A. Perform clearing and grubbing including the excavation, removal and disposal of roots, stumps, sod, or any organic material and buried debris from within construction limits. Remove unsuitable material to at least 12 inches (30cm) below subgrade elevation.
- B. Stockpile for project use any topsoil removed by clearing and grubbing.
- C. Dispose of all Clearing and Grubbing material as specified.

### 3.2 EXCAVATIONS STABILITY AND SAFETY

- A. Meet OSHA requirements for excavations and excavated material stockpiles. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

### 3.3 PROTECTION OF PROPERTY

- A. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, fences, and vegetation. Any disturbed or damaged facilities will be suitably restored or replaced consistent with conditions(s) which existed prior to construction.
- B. Privately owned structures located within the existing right of way and within construction limits of the project shall not be removed until directed by the Engineer. Take care in removing such items so as to minimize the damage to the structures.

### 3.4 EXCAVATION

- A. Excavate to the specified lines and grades. Excavate without causing rutting, pumping or other disturbance to underlying materials.
- B. Excavation made outside the specified grade limits is not measured for payment in the Excavation or Embankment In-Place quantities.
  - 1. Restore overexcavated areas as directed by the Engineer. Correct subgrade disturbance by removing the disturbed soil and replacing and compacting to reach at least 95% of the maximum laboratory dry density determined by AASHTO T99 or ASTM D698.
  - 2. Correct subgrade disturbance before placing overlying fill, backfill, base course or other courses. Disturbed soils may be replaced with imported material approved by the Engineer and compacted to 95% of maximum laboratory dry density determined by AASHTO T99 or ASTM D698.
- C. Maintain the subgrade to drain at all times. Construct side ditches or gutters from cuts to embankments to prevent erosion damage to embankments.
- D. Construct and maintain temporary drainage where existing surface drainage, sewers, or under-drainage are disturbed during the work until permanent drainage facilities are completed. Protect and preserve all existing drains, sewers, sub-surface drains, conduits, gas lines, and other underground structures which may be affected by the work. Repair all damage to these facilities or structures resulting from the work, to the satisfaction of the Engineer.



- E. Excavate to minimize foundation and/or subgrade soil exposure to erosion, drying or infiltrating moisture. Perform excavation to provide drainage away from foundation/subgrade soils and minimize the potential for surface runoff to enter the foundation/subgrade soils.
- F. Grade all intersecting streets and approaches within the project limits as specified or as directed using suitable materials on the surfaces to produce smooth riding and satisfactory approaches to the intersections.

### 3.5 DISPOSAL OF EXCAVATED MATERIAL

- A. Dispose of debris and unused excavated materials off the project site in accordance with all applicable state and local regulations. Locate and provide suitable disposal areas.

### 3.6 DUST CONTROL

- A. Furnish dust control meeting Section 01500, Construction and Temporary Facilities, requirements.

### 3.7 SUBGRADE PREPARATION AND COMPACTION

#### A. General

1. Assure the subgrade beneath pavements, curb, or sidewalks is natural soil free of topsoil, organic material or refuse. Place subbase, base courses, and pavement components, curb and sidewalk over the prepared subgrade as soon as practical. Do not place components on frozen subgrade. No separate payment is made for subgrade preparation, since it is considered incidental to construction of overlying pavements/structures.
2. If the surface of a previous roadbed or pavement surface matches the surface of the finished subgrade, scarify the top 6 inches (15cm) of the previous surface the full width of the subgrade to permit uniform reshaping and compaction.

#### B. Fine Grading

1. Assure the finished surface does not deviate not more than 0.1 foot (3cm) at any point from the staked elevation; and that sum of the deviations from true grade of any two points less than 30 feet (9m) apart does not exceed 0.1 foot (3cm).

#### C. Compaction

1. Compact the upper 8-inches (20 cm) of the subgrade to at least 95% of the

laboratory maximum, determined by AASHTO T99 or ASTM D698. Proof roll the subgrade surface for observation by the Engineer. Compact all soft, yielding or otherwise unstable areas to provide adequate support of construction equipment as determined by the Engineer. Also compact the subgrade to meet the specified density requirements. Remove and replace any unstable or otherwise unsuitable subgrade as specified under Section 3.9, Subexcavation/Replacement Below Subgrade.

### 3.8 EMBANKMENT PLACEMENT AND COMPACTION

#### A. General

1. Place fill materials (embankment) to the specified lines and grades. Place fill in uniform layers not exceeding 8 inches (20cm) in loose thickness. Once placed, moisten or aerate, mix, and compact each layer as specified. Work clay soils to maximum 2-inch (5cm) nominal size before compacting. Do not begin fill placement until the subgrade construction has been approved by the Engineer. Do not place fill on wet or frozen areas. Do not operate heavy equipment for spreading or compacting fill within four feet (1.2m) of structures.
2. If grading operations are suspended due to weather, blade the entire area until it is smooth, free of depressions and ruts, and crowned to drain water.

#### B. Compaction

1. Control the fill moisture content to assist in obtaining the specified field density. Maintain the moisture content of fill soils within  $\pm 3$  percent of optimum moisture. Compact each fill layer and the top 8 inches (20cm) of subgrade soil to at least 95% of maximum laboratory density as determined by AASHTO T99 or ASTM D698. Compact areas within four feet (1.2M) of structures in maximum 8 inch (20cm) loose lifts using power-driven hand held tampers.
2. Apply water, when required, at the locations and in the amounts required to compact the material to the specified requirements. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application. Apply water during the work to control dust and to maintain all embankment and base courses in a damp condition in accordance with Section 1500. Water required for compacting subgrade and/or embankments may be obtained from the municipal system if approved by the Owner, or from other sources.
3. Do not place fill or embankment when moisture content prevents effective compaction or causes rutting. Dry all embankments having excessive

moisture by scarifying and blading the affected areas before compacting or placing succeeding layers.

### 3.9 SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE

- A. Subexcavation consists of removing and disposing of unsuitable material from below planned subgrade elevation in cut sections or from the natural groundline in embankment sections.
- B. Soil is unsuitable if, in the opinion of the Engineer, it contains excessive organics, refuse, construction debris, or other objectionable material; or if it is unstable, rutting or yielding; or if it contains excessive moisture. Generally, soils will be subexcavated and replaced only if they are unable to adequately support equipment typically used for excavation and soil transport.
- C. Assure the Engineer has measured the area where unstable materials have been removed before backfilling. Do not backfill any area where unstable foundation soils have been excavated until authorized by the Engineer. Backfill placed without approval may be ordered removed and replaced at Contractor expense.
- D. Backfill with either suitable soils from within the project limits or imported pitrun gravel complying with the requirements of Section 2.3, Subexcavation/Replacement Below Subgrade. Different measurement and payment items are used for the on-site and pitrun gravel replacements.
- E. Compact the replacement material to 95 percent of the maximum laboratory density as determined by AASHTO T99 or ASTM D698.

### 3.10 PROTECTION OF THE WORK

- A. Repair damaged embankments to the specified elevations and grades. Maintain ditches and drains along the subgrade to drain the subgrade. Assure the finished grade does not deviate more than 0.1 (3cm) foot at any point from the staked elevation and the sum of the elevations from true grade of any two points not more than 30 feet (9m) apart does not exceed 0.1 foot (3cm). Do not place any surface course or pavement until the subgrade has been checked and approved by the Engineer.

## **PART 4: MEASUREMENT AND PAYMENT**

### 4.1 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- A. EXCAVATION ABOVE SUBGRADE
  - 1. Measure excavation by the cubic yard in its original position. Payment for excavation will be according to the designed quantities as shown in

the bid schedule unless it is determined by the contractor and verified by the Engineer that errors exist in the original design that cause the pay item quantity to change by 10 percent or more. This item includes all labor, tools, equipment, and other incidentals necessary to excavate material above subgrade in its original position, haul, place, level, manipulate, compact the embankment material in its final position, and perform other incidental work required for excavation and embankment construction. Payment is made under: Road, Trail, and Parking Excavation.

**A. SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE**

1. This item is field measured using the average end area method and paid for by the cubic yard (cubic meter) in-place of material removed, measured in its original position, at a unit price mutually agreed upon between the Owner and the Contractor for Subexcavation/Replacement Below Subgrade, which price and payment constitutes full compensation for all labor, equipment, tools, and incidentals to complete the excavation and disposal of unsuitable material in the embankment foundation or in the subgrade. The cost of backfilling and compacting holes created by the removal of unsuitable material with the specified replacement material is also included in Subexcavation/Replacement Below Subgrade Item. Payment for this work will be made under SECTION 01800 MISCELLANEOUS WORK.

**C. EMBANKMENT IN PLACE**

1. Embankment in place will not be measured for payment. All embankment construction that is required for this project will be considered incidental to roadway excavation. Quantities of embankment shown on the drawings are for information only and are only approximate.

**END OF SECTION**

## SECTION 02234

### SUB BASE COURSE

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work is constructing a sub-base course of either crushed or un-crushed materials meeting the specified gradations and other quality criteria specified herein.

##### 1.2 REFERENCES

AASHTO T11	Amount of Material Finer than No. 200 (0.075 mm) Sieve in Aggregate
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T89	Determining Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T176	Sand Equivalent Value of Soils and Fine Aggregate
AASHTO T96	Resistance to Degradation By Abrasion and Impact in the Los Angeles Machine
AASHTO T99 (ASTM D698)	Moisture-Density Relation of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5 kg) Rammer and 12-in (305 mm) Drop
ASTM D5821	Determine the Percentage of Fractured Particles in Coarse Aggregate
AASHTO T191 (ASTM D1556)	Density of Soil In-Place By Sand Cone Method
AASHTO T310 (ASTM D6938)	In-Place density and water content of the soil and soil aggregate by Nuclear method (Shallow Depth)

##### 1.3 DENSITY CONTROL TESTING

- A. Field Density Testing
1. Meet the quality control and quality assurance testing requirements in section 01400, Contractor Quality Control and Owner Quality Assurance.
  2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556) Sand Cone method or AASHTO T310 (ASTM D 6938), Nuclear Densometer method, Quality assurance field density testing frequency is at the discretion of the Engineer.
  3. Retesting of failing areas is at the expense of the Contractor.

**B. Laboratory Maximum Density and Optimum Moisture**

1. Moisture density curves will be provided by the Contractor for each base material supplied. These will be provided at the expense of the Contractor.

**C. Materials Submittals**

1. Submit to the Engineer gradations, moisture density curves and other preliminary test results for sources to be used for base materials prior to delivery to the site for approval by the Engineer. If recycled materials are proposed, CBR test data must be submitted to the Engineer to assure consistency with design requirements.

**PART 2: PRODUCTS**

**2.1 GENERAL**

- A. Furnish select sub-base material meeting the applicable aggregate quality.

**2.2 UNCRUSHED SUB BASE**

- A. Furnish material consisting of hard, durable stone, gravel or other similar materials mixed or blended with sand, stone dust, recycled concrete and/or asphalt or other binding or filler materials produced from approved sources, providing a uniform mixture meeting these specifications and compacted into a dense and well-bonded sub base. Oversize material of acceptable quality may be crushed and used in the base material, if the blend meets the specified gradations.
- B. Assure the material retained on the No. 4 sieve has a wear not exceeding 50 percent at 500 revolutions as determined by AASHTO T96.

**2.3 CRUSHED SUB-BASE**

- A. Furnish material having both fine and course crushed stone or crushed gravel, and/or natural gravel, and when approved, blended with soil, sand, screenings, recycled concrete and/or asphalt or other materials.
- B. Furnish crushed gravel or stone consisting of hard, durable particles, not containing excessive flat, elongated, soft or disintegrated rock, dirt, or other deleterious matter, and having a wear not exceeding 50 percent at 500 revolutions as determined by AASHTO T96.
- C. Use production methods that produce a percent of fractured rock in the finished product that is constant and uniform. Crush aggregate so that at least 25% of the material is retained on the No. 4 sieve and has one or more mechanically fractured faces.

## 2.4 GRADATION

- A. Produce material, including any added binder or filler, meeting the following Table of Gradations as determined by AASHTO Methods T11 and T27:

### TABLE OF GRADATIONS

#### PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVES

Passing	3" Minus
3 Inch	100
2 Inch	—
1 ½ Inch	—
1 Inch	—
No. 4	25-60
No. 400	10-30
No. 200	2-12

- B. Up to 5% “oversized” material is permitted provided that the “oversized” material passes the screen size immediately larger than the top size specified. The material between the maximum screen opening and the No. 4 sieve shall be reasonably well graded.
- C. Suitability of the aggregate is determined by the gradation testing of material placed in the project as required in the Contract documents, within the allowable limits described by the Table of Gradations for the particular grading specified.
- D. Assure the liquid limit for the aggregate fraction passing a No. 40 sieve does not exceed 25, nor the plasticity index exceed 6, as determined by AASHTO T89 and T90.

## 2.5 WATERING

- A. Use uncontaminated water.

## PART 3: EXECUTION

### 3.1 PREPARATION

- A. Immediately before placing the base course, blade smooth and shape the underlying subgrade, sub-base or base course to the plan cross section before the base course is placed on the street. Do not place sub base course on wet or muddy subgrade or sub-base course. Maintain at least one completed area of finished and accepted subgrade or sub-base course in advance of placing base course.

### 3.2 PLACEMENT AND SPREADING

- A. Mix and place the material in maximum 6-inch (15 cm) horizontal layers loose thickness. Deposit and spread each load of material on the prepared subgrade, or on a completed sub base course layer continuously without breaks. Assure hauling over the subgrade or over any completed sub base course does not damage the subgrade, sub base or base course.
- B. Spread using dump boards, spreader boxes, or moving vehicles equipped to distribute the material in a uniform layer or a windrow. Place and spread the material in a uniform layer to the specified depth without causing segregation. Once the base course is spread, blade-mix it the full depth by alternately blading the entire layer to the centerline and back to the roadway edge.
- C. For multiple layers, mix each layer as specified above. Blade smooth and compact each layer before placing the succeeding layer.
- D. Uniformly add water, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.
- E. Apply water during the work to control dust and to maintain the base course in a damp condition.
- F. Where crushed sub-base is specified, produce a product with at least 25% of the material retained on the No. 4 sieve having one or more fractured faces.
- G. Water required for compacting base gravel may be obtained from the municipal system if approved by the Owner, or from other sources.
- H. Compact the material using appropriate tamping equipment or power rollers. Correct all irregularities or depressions that develop under rolling by scarifying the material and adding or removing material, as required, until the surface meets specifications.
- I. Blade and compact alternately, as required to produce the specified surface until final inspection. Tamp the material along curbs, headers, manholes, and similar structures and all places inaccessible to rollers using approved mechanical tampers or hand tampers meet field density requirements.

### 3.3 FIELD DENSITY REQUIREMENTS

- A. Furnish watering and rolling to obtain a minimum field density of 95 percent of the maximum dry density determined by AASHTO T99. No separate compensation is allowed for rolling and watering the sub-base course other than the sub-base course bid item or items listed on the Contract documents.

### 3.4 SURFACE TOLERANCES



- A. Finish the sub-base course so that when tested using a 10-foot (3 m) straight edge placed on the surface with its center line parallel to the street center, the maximum surface deviation from the straight edge does not exceed ½-inch (12.7 mm). Additionally, the finished grade cannot deviate more than 0.1 foot (30 mm) at any point from the staked elevation and the sum of the deviations from two points not more than 30 feet (9.14 m) apart cannot exceed 0.1 feet (30 mm).
- B. Perform all sub-base course corrections to meet the above tolerances using approved methods and materials. Payment for patching aggregate is at the unit price bid for the sub-base course material.

**PART 4: MEASUREMENT AND PAYMENT**

**4.1 CUBIC YARD BASIS: SUB BASE COURSE**

- A. This item is measured and paid for by the cubic yards (cubic meters) of uncrushed or crushed, sub base course of the specified gradations, complete in place, at the contract unit price bid for Sub base Course, which constitutes full compensation for furnishing, loading, hauling, spreading, blending, shaping, watering, and compacting the sub-base course material, and for all tools, labor and incidentals necessary to complete this item.

**END OF SECTION**

**SECTION 02235**  
**CRUSHED BASE COURSE**

**PART 1: GENERAL**

**1.1 DESCRIPTION**

- A. This work is the placing of one or more courses composed of crushed gravel, stone or other similar materials meeting the gradation and other quality criteria specified herein.

**1.2 REFERENCES**

AASHTO T11	Amount Finer than No. 200 (0.075 mm) Sieve in Aggregate
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T89	Determining Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T176	Sand Equivalent Value of Soils and Fine Aggregate
AASHTO T96	Resistance to Degradation By Abrasion and Impact in the Los Angeles Machine
AASHTO T99 (ASTM D698)	Moisture-density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5 kg) Rammer and 12-Inch (305 mm) Drop
ASTM D5821	Determining the Percentage of Fractured Particles in Coarse Aggregate
AASHTO T191 (ASTM D1556)	Density of Soil In-Place By Sand Cone Method
AASHTO T238 (ASTM D2922)	Density of Soil and Soil-Aggregate In-Place By Nuclear Method (Shallow Depth)
AASHTO T239 (ASTM D3017)	Moisture Content of Soil-Aggregate In-Place By Nuclear Method (Shallow Depth)

**1.3 DENSITY CONTROL TESTING**

- A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements in section 01400, Contractor Quality Control and Owner Quality Assurance.
  2. In-place field density tests for quality assurance are at Contractor expense meeting AASHTO T191 (ASTM D1556) Sand Cone method or AASHTO T310 (ASTM D6938) Nuclear Densometer method. Quality assurance field density testing frequency is at the discretion of the Engineer.
  3. Retesting of failing areas is at the expense of the Contractor.
- B. Laboratory Maximum Density and Optimum Moisture
1. Moisture density curves will be provided by the Contractor for each base material provided. These will be provided at the expense of the Contractor.

#### 1.4 MATERIALS SUBMITTALS

1. Submit to the Engineer gradations, moisture density curves and other test results for sources to be used for base materials prior to delivery to the site for approval by the Engineer. If recycled materials are proposed, CBR test data must be submitted to the Engineer to assure consistency with design requirements.

## **PART 2: PRODUCTS**

### 2.1 GENERAL

- A. Furnish aggregate base material meeting the applicable aggregate quality requirements.
- B. Furnish Base One® a liquid-based aggregate stabilization product that is diluted and applied with water, manufactured by Team Labs or approved equal. Team Labs is located at 28650 State Highway 34, Detroit Lakes, MN 56501. Contact: David West, Team Labs, 1-800-721-9537.
- C. Furnish equipment capable of mixing the liquid based aggregate stabilization product with the crushed base material at the specified application rates.

## 2.2 CRUSHED BASE MATERIAL

- A. Consists of both fine and coarse fragments of crushed stone or crushed gravel, and/or natural gravel, and when approved, blended with sand, finely crushed stone, crusher screenings, recycled concrete and/or asphalt or other similar materials.
- B. Use crushed stone or gravel consisting of hard, durable particles of fragments of stone, free of excess of flat, elongated, soft or disintegrated pieces, dirt, or other deleterious matter, and having a percent of wear of not exceeding 50 at 500 revolutions when tested under AASHTO T96.
- C. Crush material so that the percentage of fractured particles in the finished product is as constant and uniform as practical. Crush to produce material where at least 35 percent of the material retained on the No. 4 sieve has at least one fractured face.
- D. Incorporate all material produced in the crushing operation and passing the No. 4 mesh sieve into the base material necessary to meet the gradation requirements.

## 2.3 GRADATION

- A. As determined by AASHTO Methods T11 and T27, furnish material for the grading specified in the contract documents including binder or filler, which may have been added at the plant or at the site, meeting the requirements of that grading in the Table of Gradations below:

### **TABLE OF GRADATIONS**

#### **PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE**

**$\frac{3}{4}$ " minus Crushed Base Course  
(for treated and untreated applications)**

<b>Sieve Designation</b>	<b>Percentage of Weight Passing Sieves</b>
$\frac{3}{4}$ inch	100
$\frac{1}{2}$ inch	—
No. 4 Sieve	40 - 70
No. 10 Sieve	25 - 55

No. 200 Sieve      2 - 10

**Choker Aggregate**

<b>Sieve Designation</b>	<b>Percentage of Weight Passing Sieves</b>
3/8 inch	100
No. 4 Sieve	70 - 100
No. 200 Sieve	0.0 – 5.0

- B. Up to 5% “oversized” material is permitted provided that the “oversized” material passes the screen size immediately larger than the top size specified. The produced material between the maximum screen opening and the No.4 sieve shall be reasonably well graded.
- C. Suitability of the aggregate is based on samples obtained during placement in the project within limits allowed in the table for the particular grading specified.
- D. That portion of the fine aggregate passing the No. 200 sieve must be less than 60 percent of that portion passing the No. 40 sieve.
- E. The liquid limit for that portion of the fine aggregate passing a No. 40 sieve cannot exceed 25, nor the plasticity index exceed 6, as determined by AASHTO T89 and T90.

**2.4 WATERING:**

- A. Use uncontaminated water.

**PART 3: EXECUTION**

**3.1 GENERAL**

- A. Before placing the base course, smooth and shape the surface of the underlying subgrade, sub-base or base course to the cross section shown on the plans before placing the base course.

- B. Do not place base course on a wet or muddy subgrade or sub-base course. Complete at least one area of finished and accepted subgrade, sub-base or underlying base before the placing of any base course.

### 3.2 PLACEMENT AND SPREADING – CRUSHED BASE COURSE (UNTREATED) AND CRUSHED AGGRERATE SURFACING

- A. Mix and place the material in maximum 8 inches compacted layers unless otherwise approved. Deposit and spread each load of material on the prepared subgrade, or on a completed sub-base or base course layer continuously without interruption. Discontinue operating haul units over subgrade, or over any sub-base or base course completed if the haul units damage the subgrade, sub-base or base course.
- B. Deposit and spread the material in a uniform layer, without segregation, to a loose depth so that when compacted, and making allowance for any filler to be blended on the road, the layer has the specified thickness.
- C. Spread material using dump boards, spreader boxes, or vehicles equipped to distribute the material in a uniform layer. The material may be deposited in windrows mixed and spread as described below.
- D. Construct each layer meeting these requirements. Blade smooth and thoroughly compact each layer as specified before placing the succeeding layer.
- E. If segregation or moisture problems exist, or if the material was placed on the road in windrows, thoroughly blade-mix the material of the affected layer by alternately blading to the center and back to the edges of the street or trail.
- F. Uniformly add water, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application. Adhere to all weight limits governing equipment that may be used to construct the portion of the trail below the I-90 bridges.
- G. Apply water during the work to control dust and to maintain the base course in a damp condition in accordance with Section 01500 under Dust Control.
- H. The Contractor is responsible for supplying water required for compacting base gravel.

### 3.3 PLACEMENT AND SPREADING – CHOKER AGGREGATE

- A. Place and spread the material over the prepared riprap base ensuring that all riprap voids are filled to the depth shown on the drawings.
- B. Compact using approved methods until visible surface deformation ceases. Prepare surface for placement of crushed base course material.

### 3.4 PLACEMENT AND SPREADING – TREATED AGGREGATE BASE

- A. Deposit and spread the material in a uniform layer using dump boards, spreader boxes, or vehicles equipped to distribute the material in a uniform layer. Spread material without causing segregation, to a loose depth so that when compacted, the layer has the specified thickness. Adhere to manufacturer's recommendations for lift thickness if applying stabilizer using the spray method.
- B. Spread material using dump boards, spreader boxes, or vehicles equipped to distribute the material in a uniform layer. The material may be deposited in windrows and spread as described below.
- C. Inject liquid based aggregate stabilization product into base course material at a rate of 0.0075 gallons per square yard per inch of base course depth. Apply water as recommended by the manufacturer of the liquid stabilizer.
- D. Use equipment capable of injecting or spraying the liquid stabilizer to uniformly coat the base course material at the rate specified. If the stabilizer is sprayed onto the surface, follow the manufacturer's recommendations for maximum lift thickness prior to spraying. Multiple smaller lifts may be required to achieve proper coverage.
- E. Contractor shall perform moisture tests at intervals specified by the Engineer to determine the moisture content of the treated base course material. The results of the moisture tests should be used in conjunction with moisture/density values, determined using ASTM D698, to determine the application rate of the liquid stabilizer/water mixture and subsequently the ratio of liquid stabilizer to water.
- F. Mix and place the material in maximum 4 inch compacted layers unless otherwise approved. Deposit and spread each load of material on the prepared subgrade continuously without interruption. Discontinue operating haul units over

subgrade, or over any sub-base or base course completed if the haul units damage the subgrade, sub-base or treated base course.

- G. When compacting each layer, initially use a sheepfoot vibratory roller that is self-propelled and has a minimum weight of 25,000 pounds. The contractor shall additionally utilize either a vibratory steel drum roller capable of producing 250 lbs/in of drum width or a pneumatic tired roller (self-propelled or towed) having a compacting width of 5 feet or more and sufficient mass to provide 100-250 lbs./in of rolling width.
- H. The contractor shall compact the treated base course layer to a minimum of 95 percent of ASTM D698. During the reclamation and compaction process, the contractor shall provide sufficient water so the reclaimed mixture will be at +/- 2 percent of the optimum moisture content per ASTM D698. All treated base course material shall be blended, spread, shaped, watered, and compacted by the end of the workday.
- I. Following construction of the treated base course layer and prior to placing the bituminous surface treatment, the contractor shall maintain the surface so it is free of ruts, washboards, and potholes. This may require application of water and using a scarifying blade on a road grader. Reclaimed material with a “wash board” surface condition shall be scarified to a depth below that lowest surface of the wash boarded area and re-compacted immediately prior to paving. This work shall be performed at no additional cost to the Owner. Any costs associated with maintaining this surface is considered incidental to the construction of the treated base course layer.
- J. The contractor shall allow the treated base course surface to cure for a **minimum of 10 calendar days** prior to placement of bituminous surface treatment. Traffic will be allowed to travel on the surface upon completion of compaction. Should the Base One®-treated surface be exposed to significant rainfall (more than 4 hours of continuous rainfall per day) during the recommended 10 day cure period, the reclaimed material should be allowed a minimum of one additional ‘dry’ day (no rainfall) to cure for each day where rain fell for more than 4 hours.
- K. Prior to paving, water shall be applied as directed by the engineer for dust control.

### 3.5 FIELD DENSITY REQUIREMENTS

- A. Compact placed material the full width by rolling with suitable tamping equipment or power rollers. Correct all irregularities or depressions that develop during rolling by loosening the material in these places and adding or removing material, as required.



- B. Perform blading and compacting alternately as required or directed, to maintain a smooth, even, uniformly compacted surface until the final inspection. Along curbs, headers, manholes, and similar structures, and at all places not accessible to the roller, compact the base course material with suitable mechanical tampers or hand tampers to reach the compaction requirements.
- C. Provide the watering and rolling required to obtain a minimum field density of 95 percent of maximum dry density as determined by AASHTO T99. No separate compensation is made for rolling and watering the base course other than the base course bid item or items listed on the contract documents.

### 3.6 SURFACE TOLERANCES

- A. The base course surface when finished and tested with a 10-foot (3.0 meter) straight edge placed on the surface with its center line parallel to the center line of the street, will not have a surface deviation from the straight edge exceeding 3/8-inch (1.0 centimeter). Additionally, the finished grade cannot deviate more than 0.05 feet (1.5 centimeters) at any point from the staked elevation, and further, the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.05 feet (1.5 centimeters).
- B. For base course receiving asphalt concrete surfacing or bituminous surfacing, the finished grade cannot deviate more than 0.02 feet (0.6 centimeters) at any point from the staked elevations, and the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.02 feet (0.6 centimeters).
- C. If patching of the base course is necessary to meet the tolerances, perform patching using methods and aggregates approved by the Engineer.

## **PART 4: MEASUREMENT AND PAYMENT**

### 4.1 CRUSHED BASE COURSE

- A. Measure crushed base course by the cubic yard in its final position. Payment for crushed base course will be according to the designed quantity as shown in the bid schedule unless it is determined by the Contractor and verified by the Engineer that errors exist in the original design that cause the pay item quantity to change by 10 percent or more. Payment will be full compensation for the work prescribed in this Section.

#### 4.2 TREATED AGGREGATE BASE

- A. Measure treated aggregate base by the cubic yard in its final position. Payment for treated aggregate base will be according to the designed quantity as shown in the bid schedule unless it is determined by the Contractor and verified by the Engineer that errors exist in the original design that cause the pay item quantity to change by 10 percent or more. No separate payment will be made for liquid stabilizer. Payment will be full compensation for the work prescribed in this Section.

#### 4.3 CHOKER AGGREGATE.

- A. Measure choker aggregate by the cubic yard in its final position. Payment for choker aggregate will be according to the designed quantity as shown in the bid schedule unless it is determined by the Contractor and verified by the Engineer that errors exist in the original design that cause the pay item quantity to change by 10 percent or more. Payment will be full compensation for the work prescribed in this Section.

**END OF SECTION**

## **SECTION 02310**

### **GABION RETAINING WALL**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This work shall consist of constructing a gravity wall of rock filled wire mesh gabions.

##### **1.2 REFERENCES**

- A. The current publications listed below form a part of this specification.

ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A641	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A90	Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A764	Standard Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs
ASTM A313	Standard Specification for Stainless Steel Spring Wire

#### **PART 2: PRODUCTS**

##### **2.1 GABIONS**

- A. MESH
  - 1. Gabion panels for the base, ends, sides, diaphragms, and lids may be fabricated from welded wire mesh. Only one type of wire mesh may be used in any one structure. Welded wire shall comply with the following requirements:

<u>Characteristic</u>	<u>Test Designation</u>	<u>Requirements</u>
Minimum Tensile Strength	ASTM A370	60,000 psi
Wire Size Wire Diameter Minimum Galvanizing	USA Steel Wire Gage  ASTM A641, and ASTM A90	11 0.120 in. 0.116 in. 0.80 oz/sf
Wire Size Wire Diameter Minimum Galvanizing	USA Steel Wire Gage  ASTM A641, and ASTM A90	9 0.148 in. 0.144 in. 0.90 oz/sf

2. Welded wire mesh shall also conform to ASTM A185 except that the weld shears shall be 600 pounds force for 11-gage and 800 pounds force for 9-gage wires. All wire gages are United States Steel Wire Gage after galvanizing.
3. Gabion panels of the welded wire mesh shall be manufactured from 11-gage or 9-gage. The mesh shall form a nominal 3 in. by 3 in. square grid pattern and shall be made by resistance welding in accordance with ASTM A185. The maximum diagonal dimension of any grid opening shall not exceed 4.75 in.

#### B. FABRICATION

1. Gabions shall be fabricated in such a manner that the sides, ends, lids, and diaphragms can be assembled at the construction site into a rectangular basket of required sizes. Gabions shall be of a single unit construction. The base, ends, and sides shall either be woven into a single unit or one edge of these members connected to the base section of the gabion in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh.
2. Where the length of the gabion exceeds its horizontal width, the gabion shall be equally divided by diaphragms, of the same mesh and gage as the body of the gabion, into cells whose length does not exceed the horizontal width. The gabion shall be furnished with the necessary diaphragms secured in proper position on the base section in such a manner that no additional tying at this juncture will be necessary.
3. The height, length, and width of the gabions shall not vary more than 5 percent from the dimensions shown on the plans

4. All perimeter edges shall be securely selvaged or bound so that the joints formed by tying the selvages shall have the same strength as the body of the mesh.

#### C. PACKING AND MARKING

1. Gabions shall be shipped folded flat in bundles not to exceed 1200 lbs (545 kg) in weight. Each bundle shall contain gabions of one size except that odd numbers necessary to complete an order may be made into a bundle of less than the uniform number. This bundle shall be clearly marked to identify it from all others. Each gabion shall be clearly marked by color code, or some other readily identifiable means to indicate size. Bundles shall not be handled by lifting on gabion mesh to avoid damage to wire or galvanizing.

#### D. JOINTS

1. Wires used to form joints shall conform to the definitions and requirements of ASTM A 641 for “carbon steel”, zinc-coated wire and shall meet the following requirements:

<u>Characteristic</u>	<u>Test Designation</u>	<u>Requirements</u>
Minimum Tensile Strength	ASTM A370	60,000 psi
Wire Size	USA Steel Wire Gage	13.5
Wire Diameter		0.086 in.
Minimum Galvanizing	ASTM A641, and ASTM A90	0.083 in. 0.72 oz/sf
Wire Size	USA Steel Wire Gage	9
Wire Diameter		0.148 in.
Minimum Galvanizing	ASTM A641, and ASTM A90	0.144 in. 0.90 oz/sf

2. Spiral binders shall have a 3 in. separation between continuous, successive loops.
3. Internal connecting wires or preformed stiffeners shall be at least 13.5-gage. Each wire shall also meet the minimum requirements of the wire in this specification.
4. The contractor can request acceptance of alternative fasteners. Alternative fasteners shall be fabricated such that when the ends are brought together and properly closed, the fastener forms a closed loop with an overlap of at least 1 in. The closed loop shall have an inside area that is large enough to enclose up to 4 selvaged wires.

5. Fasteners shall conform to ASTM A764, and shall have the same weight of coating as specified in ASTM A641. Stainless steel shall conform to ASTM A313 for applications involving PVC coated gabion baskets. The fastener shall resist a direct tension force across any axis, of at least 600 pounds force while remaining closed. Random samples of fasteners shall be submitted for testing at least 10 working days prior to construction of gabions. The contractor shall submit 12 formed and 12 unformed fasteners. Formation of the 12 formed fasteners shall be done at the job site by the contractor and shall be witnessed by the Engineer. Fasteners shall be spaced at intervals of 4 in. to 6 in. with at least one fastener per gabion mesh opening.

#### E. TESTING

1. When ordered by the Engineer, gabions which have not been previously tested and approved, shall be tested as follows.
2. Cubical-Celled Gabions – Wire mesh of gabions with a 3-ft by 3-ft square cross section shall have sufficient strength and flexibility when assembled and filled with rock to pass the following test:
  - a. Loading and Configuration: Place an approximate 4000-pound line load over the center of a 12-ft long gabion (perpendicular to the long axis), which is unsupported under the middle 6 ft. and anchored at both ends. (A piece of concrete pipe 4 ft diameter or less, weight about 4000 pounds, can be used to impose the required line load on the gabion).
  - b. Requirements: Deflection at the unsupported mid span shall be no greater than 0.50 ft. There shall be no visible reduction of wire size in any panel, no loss of internal rock, and no unraveling of twisted-mesh or weld breaks in welded-mesh.
3. Those systems which have been previously tested and approved by the Engineer shall be accepted for use upon the approval of the Engineer. The costs associated with testing gabions shall be incurred by the Contractor for all gabions that fail the test. The cost associated with testing gabions that pass the testing requirements will be paid for by the Owner if the gabions also satisfy the other requirements of this provision.

## 2.2 GABION FILL MATERIAL

- A. The fill material for the wire gabions shall be rock ranging in size from a minimum of 4 in. to a maximum of 8 in., both measured in the greatest dimension. Rock shall be sound, durable, well graded, and shall not disintegrate on exposure to water or weathering during the life of the structure. Rock for

gabions shall be obtained from a source approved by the Engineer. The minimum unit weight of a rock-filled gabion shall be 110 lbs/cu. ft. Verification of the gabion unit weight shall be done when ordered by the Engineer.

### **PART 3: EXECUTION**

#### **3.1 PREPARATION OF FOUNDATION**

- A. The foundation for gabion structures shall be excavated to the lines and grades shown on the plan or as directed by the Engineer.
- B. Excavation for the gabion structure footing shall be to the elevation shown on the plans or as directed by the Engineer to fit field conditions. Where soft, yielding material is encountered, the material shall be removed below the foundation grade for a depth of at least 2 ft. or as directed by the Engineer. The width of the excavation shall be at least 6 in. greater than the bottom width of the wall. The excavation below grade shall be backfilled with granular material and compacted in layers not to exceed 6 in. in uncompacted depth to form a uniform foundation. Slipouts caused by the Contractor's operations shall be repaired by the Contractor to the satisfaction of the Engineer at the Contractor's expense.

#### **3.2 GABION BASKET ASSEMBLY**

- A. Gabions shall first be assembled individually as empty units. Each gabion shall be manufactured with the necessary panels, properly spaced and secured, so they can be rotated into position at the construction site with no additional tying of the rotation joint. The panels and diaphragms shall be rotated into position and joined along vertical edges.
- B. Welded wire mesh panels shall be joined along the vertical edges with spiral binders or lacing ties.
- C. When 13.5-gauge tie wire is used as the joint material, all vertical edges of each gabion panel shall first be constructed to form individual empty gabions. Simple spiraling (looping without locking) of 13.5-gauge tie wire is not permitted. For welded-mesh, the joint shall be constructed using alternating single and double half hitches (locked loops) in every mesh opening along the joint.
- D. When 9-gauge spiral binders are used, the spiral shall be screwed into position such that it passes through each mesh opening along the joint. Both ends of all 9-gauge spiral binders shall be crimped to secure the spiral in place.
- E. Twisted wire mesh panels shall be joined along the selvedged vertical edges with tie wire or locking wire fasteners. When tied, they shall be joined with tie wire at 4 in. nominal spacing with alternating single and double locked loops as shown

on the plans. When lock wire fasteners are used, they shall be applied at each mesh opening.

- F. For either mesh style there shall not be any opening greater than 4.75 in. (maximum line dimension) along the joined edges or at the corners of the gabion baskets.
- G. The wire mesh panel (base, ends, sides, diaphragms, and lid) shall be assembled such that the strength and flexibility at the connections is at least equal to that of a single panel.

### 3.3 ERECTION OF GABION STRUCTURE

- A. The empty gabion baskets shall be placed on a smooth, firm foundation. Each row, tier, or layer of baskets shall be reasonably straight and shall conform to the line and grade shown on the plans or established by the Engineer. The empty gabion baskets shall be fastened to the adjacent baskets along the top and vertical edges with 13.5-gauge tie wire or 9-gauge spirals. Each layer shall be fastened to the underlying layer along the front, back and ends. Fastening shall be performed in the same manner as provided for assembling the gabion units.
- B. Unless otherwise indicated on the plans, the vertical joints between basket units of adjacent tiers or layers, along the length of the structure, shall be staggered by at least one cell.
- C. Multi-layered gabion configurations shall be stepped and staggered as shown on the plans or as directed by the Engineer. When constructing multi-layered gabion configurations, each layer of gabions shall be joined to the underlying layer along the front, back, and ends, or as shown on the plans.
- D. Single-layered gabion configurations shall be staggered and joined along the front, back, and ends as shown on the plans, including tops and bottoms of adjacent gabions.
- E. Before filling each gabion with rock, all kinks and folds in the wire mesh shall be removed and all baskets shall be properly aligned. A standard fence stretcher, chain fall or steel rod may be used to stretch the wire baskets and hold alignment.

### 3.4 FILLING GABION CELLS

- A. The gabion cells shall be carefully filled with rock placed by hand and/or machine in such a manner that the alignment of the structure will be maintained and so as to avoid bulges and to minimize voids. All exposed rock surfaces shall have a reasonably smooth and neat appearance. No sharp rock edges shall project through the wire mesh.



- B. The gabion cells in any row or layer shall be filled in stages so that local deformations may be avoided. At no time shall any cell be filled to a depth exceeding 1 ft. more than any adjacent cell.
- C. When constructing with 1.5-foot high or 3-foot high gabions, pre-formed stiffeners shall be used to produce a flat, smooth external surface.
- D. Pre-formed Stiffeners shall be installed on the exposed face of the gabion prior to rock placement, two rows at 1/3 points on 3' high gabions, one row at 1/2 point in 1.5' high gabions.
- E. During filling operations, internal connecting wires shall be placed in the cells in the following manner:
  - 1. Each cell of the 3 ft. high baskets shall be filled to one-third its depth, after which connecting wires shall be laced in each direction. Each end of the connecting wires shall be looped around two mesh openings. This operation shall be repeated when the cell is two-thirds full.
  - 2. For thinner gabion baskets, internal connecting wires are not required except when 18 in. baskets are used vertically, in which case the procedure under (1) above shall be followed.
- F. The layer of rock shall completely fill the gabion basket so that the lid will bear on the rock when it is secured. The lid shall be joined to the sides, ends, and diaphragms of individual gabions and to successive gabions with in the same manner as specified for joining the vertical edges. The gabion basket lid shall be secured so that no more than 1 in. gap remains at any connection. Gabion rows or layers not completed at the end of each shift shall have the last gabion filled with rock tied internally as an end gabion.

### 3.3 BACKFILLING THE GABION STRUCTURE

- A. The area behind the gabion structure shall be backfilled with free draining granular material as approved by the Engineer.
- B. Geotextile, if required, shall be spread uniformly over the back of the gabion structure as shown on the plans. Joining edges of the geotextile shall be overlapped a minimum of 1 ft. (300 mm) and shall be anchored in position with approved anchoring devices. The Contractor shall place the backfill material in a manner that will not tear, puncture, or shift the geotextile.
- C. The granular backfill material shall be placed in layers and shall be compacted until a uniform density of not less than 95 percent of the maximum density determined by AASHTO T 99, Method C or D. The maximum thickness before

compaction shall not exceed 1 ft. (300 mm). The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density.

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 GENERAL**

- A. The following items constitute pay items for the work covered under this section. Payment for these items is full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.

##### **4.2 GABION RETAINING WALLS**

- A. Gabion Retaining Walls will be measured by the cubic yard volume of installed gabion retaining wall.
- B. All costs in connection with furnishing and construction of gabion retaining wall shall be included in the unit Contract price per cubic yard, including all labor, materials and any other incidental items required to complete gabion wall structure in accordance with the plans and these specifications.
- C. Payment is made under: RETAINING WALL - GABION WALL – Per Cubic Yard.

##### **4.5 STRUCTURE EXCAVATION**

- A. Structure excavation, and compacting backfill, will be in accordance with Montana Department of Transportation Standard Specifications Section 209, Structure Excavation.
- B. All costs for excavation and backfill will be considered incidental to RETAINING WALL - GABION WALL – Per Cubic Yard.

**END OF SECTION**

## **SECTION 02320**

### **SOLDIER PILE AND LAGGING WALL**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This work consists of constructing soldier pile walls.

##### **1.2 REFERENCES**

- A. The current publications listed below form a part of this specification.

ASTM A572                      Standard Specification for High-Strength Low-Alloy  
Columbium-Vanadium Structural Steel

ASTM A709                      Standard Specification for Structural Steel for Bridges

#### **PART 2: PRODUCTS**

##### **2.1 STEEL PILING**

- A. Steel Piling shall meet the requirements of the Montana Department of Transportation (MDT) Standard Specifications Section 711.02(B), Structural Steel or 711.10.1, Structural Steel Piles.
- B. Steel soldier piles, and associated steel bars, plates and angles, shall conform to ASTM A572 or ASTM A709 Grade 50 (Minimum  $F_y = 50,000$  psi), except as otherwise noted in the Plans. All steel piling may be accepted by the Engineer based on the Manufacturer's Certification of Compliance.
- C. Paint steel piling and associated steel hardware per the requirements in the MDT Standard Specifications. Provide all coats in the shop and touch-up in the field as necessary. Provide the finish coat in Gloss Black - Federal Standard Color No. FS17038.
- D. Alternate rolled steel shapes satisfying the material requirements of this provision may be substituted as approved by the Engineer such that they provide the same structural section properties (or greater) as the piles shown on the plans.

##### **2.2 CONTROLLED DENSITY FILL**

- A. Controlled Density Fill (CDF) shall meet the requirements of MDT Standard Specifications Section 551.03.2(E), Controlled Low Strength Material (CLSM) - Excavatable.

## 2.3 PRECAST CONCRETE LAGGING

- A. Furnish and Install Precast Concrete Lagging meeting the requirements of the MDT Standard Specifications for Road and Bridge Construction Section 554, Precast Concrete Products with form liner on the exposed face in accordance with Project Specification Section 03440 Architectural Wall Treatment and Anti-Graffiti Coating and Drawings.
- B. Furnish Concrete for Precast Concrete Lagging meeting the requirements of the MDT Standard Specifications Section 551, Portland Cement Concrete. The minimum design compressive strength shall be 4000psi.
- C. Furnish and Place Reinforcing Steel for Precast Concrete Lagging meeting the requirements of the Montana Department of Transportation Standard Specifications Section 555, Reinforcing Steel.

## 2.3 GRAVEL BACKFILL FOR WALLS

- A. Uniformly graded gravel (pea gravel) backfill shall be used to backfill the gap behind the wall after placement of the concrete panels. The backfill shall consist of free draining granular material, essentially free from various types of wood waste or other extraneous or objectionable materials. It shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the site or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

Sieve Size	Percent Passing
1/2"	100
3/8"	85-100
No. 4	10-30
No. 200	5.0 max

All percentages are by weight

## PART 3: EXECUTION

### 3.1 QUALITY ASSURANCE

- A. The steel soldier piles shall be placed so that the exposed face of the pile at the top is within 1-inch of the Plan location. The steel soldier pile shall be plumb, to within 0.5-percent of the length based on the total length of the pile.
- B. Welding, repair welding, and welding inspection shall conform to MDT Standard Specifications Section 556.03.10, Welding Requirements.

### 3.2 SUBMITTALS

- A. The Contractor shall submit shop plans as specified in MDT Standard Specifications Section 556.03.2, Fabrication Drawings, for all structural steel, including the steel soldier piles to the Engineer for approval.
- B. The Contractor shall submit 4 copies of a shaft installation plan not less than 30-calendar days prior to the beginning of shaft construction. In preparing the submittal, the Contractor shall reference the available subsurface data provided in the Contract test hole boring logs and the geotechnical report(s) prepared for this project. This plan shall provide at least the following information:
  - 1. An overall construction operation sequence and the sequence of shaft construction.
  - 2. List, description, and capacities of proposed equipment including but not limited to cranes, drills, augers, bailing buckets, final cleaning equipment, and drilling units. The narrative shall describe why the equipment was selected, and describe equipment suitability to the anticipated site and subsurface conditions. The narrative shall include a project history of the drilling equipment demonstrating the successful use of the equipment on shafts of equal or greater size in similar soil/rock conditions.
  - 3. Sketch showing probable equipment locations when working near the track or having potential to foul a zone 25-feet away from the track centerline.
  - 4. Details of shaft excavation methods including proposed drilling methods, methods for cleanout of the shafts, disposal plan for excavated material, Shoring design and plans, including stamped calculations if necessary, to prevent railroad embankment destabilization and a review of method suitability to the anticipated site, railroad operational safety requirements and subsurface conditions.
  - 5. Cobbles and boulders should be anticipated during installation. The Contractor shall include in the installation plan equipment and methods to advance past cobbles and boulders to the required depths. Cobbles and boulders encountered during the excavations for the soldier piles do not constitute an obstruction. Vibratory or air-rotary methods to remove boulders are not allowed.
  - 6. Details of the method(s) to install temporary casing to prevent caving, bottom heave. This shall include a review of method suitability to the anticipated site and subsurface conditions. Casing dimensions and detailed procedures for casing installation and removal shall be provided. Slurry methods to stabilize the excavation are not permitted.

7. Details of soldier pile placement including internal support bracing and centralization methods.
  8. Details of concrete placement including proposed operational procedures for pumping and/or tremie methods.
  9. Details of the device used to prevent unauthorized entry into a shaft excavation.
- C. The Contractor shall submit shoring plans and calculations, stamped by a Montana PE as specified in the Railroad Guidelines for Temporary Shoring, for temporary casing and shoring required to construct soldier pile walls that lie within the influence of Railroad track surcharge to the Engineer for approval.
- D. The Contractor shall submit shop plans as specified in MDT Standard Specifications Section 554.03.1, Fabrication Drawings, for precast concrete lagging panels to the Engineer for approval.
- E. Work shall not begin until the Engineer has approved the appropriate submittals in writing.

### 3.3 SHAFT EXCAVATION

- A. The Contractor shall excavate using a temporary steel casing. Open hole excavations are not permitted. Temporary steel casing that lies within the influence of Railroad track surcharge shall be designed and constructed per UPRR-BNSF Railway Guidelines for Railroad Grade Separation Projects and UPRR-BNSF Railway Guidelines for Temporary Shoring.
- B. Shafts shall be excavated to the required depth as shown in the Plans. The minimum diameter of the shaft shall be as shown in the Plans. The excavation shall be completed in a continuous operation using equipment capable of excavating through the type of material expected to be encountered.
- C. Methods of installation that excessively vibrate the railroad embankment including air-rotary methods are not allowed. The Contractor shall monitor the site for agitation and/or settlement of the existing fill slopes during installation of the soldier piles. Cease operations and notify the Engineer immediately if any sloughing or settlement of the existing embankment occurs.
- D. The Contractor may use temporary telescoping casing to construct the shafts.
- E. If the shaft excavation is stopped the shaft shall be secured by installation of a safety cover. It shall be the Contractor's responsibility to ensure the safety of the shaft and surrounding soil and the stability of the sidewalls. A temporary casing, or other methods specified in the shaft installation plan as approved by the Engineer shall be used if necessary to ensure such safety and stability.

- F. During the time when the temporary casing is removed, the pile has been placed, and the shaft excavation is filled with CDF, the contractor must ensure stability of the shaft excavation prior to the CDF setting up. This could include; using a fast setting CDF material, timing placement of the CDF so that setup occurs before trains pass, or using other shoring methods between the tracks and the shaft excavation.
- G. If caving conditions are encountered, no further excavation will be allowed until the Contractor has developed a mitigation plan that is approved by the Engineer.
- H. No more than 12-inches of loose or disturbed material shall be present at the bottom of the shaft just prior to beginning concrete placement.
- I. The excavated shaft shall be inspected and approved by the Engineer prior to proceeding with construction.
- J. When obstructions are encountered, the Contractor shall notify the Engineer promptly. An obstruction is defined as a specific object (including, but not limited to logs and man-made objects) encountered during the shaft excavation operation that prevents or hinders the advance of the shaft excavation. Boulders do not constitute an obstruction. When efforts to advance past the obstruction to the design shaft tip elevation result in the rate of advance of the shaft drilling equipment being significantly reduced relative to the rate of advance for the rest of the shaft excavations, then the Contractor shall attempt to remove the obstruction. The method of removal of such obstructions and the continuation of excavation shall be as proposed by the Contractor and approved by the Engineer. Use of a larger diameter auger is permitted if required to remove an obstruction.
- K. Excavation of shafts shall not commence until a minimum of 12-hours after the shaft backfill for the adjacent shafts has been placed.
- L. The temporary casings for the shafts shall be removed. Vibratory equipment is not allowed to remove the temporary casing. Dual rotary drill or other suitable equipment must be used to remove temporary casing. A minimum 5-foot head of concrete shall be maintained to balance the soil and water pressure at the bottom of the casing. The casing shall be smooth.

### 3.4 INSTALLING SOLDIER PILES

- A. Soldier piles, if spliced, shall conform to all requirements of MDT Standard Specifications Section 559.02.04, Splicing Piles. The prefabricated steel soldier piles shall be lowered into the drilled shafts and secured in position. Concrete cover over the soldier pile shall be 3-inches minimum.

- B. The steel soldier piles and attachments shall be shop painted after fabrication to the limits shown in the Plans with 1 coat of zinc primer and 1 finish coat. Application of the paint shall be in accordance with MDT Standard Specifications Section 612, Paints and Painting. Apply all coats in the shop, and touch-up in the field as necessary.

### 3.5 BACKFILLING SHAFT

- A. The excavated shaft shall be backfilled with Controlled Density Fill (CDF) as shown in the Plans and subject to the following requirements:
  - 1. A wet shaft is defined as a shaft where water is entering the excavation and remains present to a depth of 6-inches or more.
  - 2. When the Plans or test hole boring logs identify the presence of a water table at or above the elevation of the bottom of soldier pile shaft, the excavation shall be considered as wet, except as otherwise noted. Such a shaft may be considered a dry shaft provided the Contractor furnishes and installs casing that is sufficiently sealed into competent soils such that water cannot enter the excavation.
  - 3. If a wet shaft exists and casing cannot be sufficiently sealed into competent soils, then polymer slurry shall be used to provide a positive head and keep water out of the shaft.
- B. Placement of the shaft backfill shall commence immediately after completing the shaft excavation and receiving the Engineer's approval of the excavation. CDF or pumpable lean concrete shall be placed in 1 continuous operation to the top of the shaft. Vibration of shaft backfill is not required.
- C. If water is not present, the shaft backfill shall be deposited by a method that prevents segregation of aggregates. The shaft backfill shall be placed such that the free-fall is vertical down the shaft without hitting the sides of the soldier pile or the excavated shaft. The Contractor's method for depositing the shaft backfill shall have approval of the Engineer prior to the placement of the shaft backfill.
- D. If water is present, the shaft backfill shall be deposited in accordance with MDT Standard Specifications Section 552.03.6, Placing Concrete Underwater.

### 3.6 INSTALLING LAGGING

- A. Temporary lagging (large steel sheet or other) must be installed as the excavation is being made to install the permanent lagging, as shown on the plans, to prevent caving of soils during excavation to install permanent lagging. Once the permanent lagging is in place, the temporary lagging sheet must be removed



without using vibratory equipment and voids backfilled with free-draining gravel as the temporary lagging sheet is removed.

- B. Permanent lagging shall be as shown in the Plans.
- C. The excavation and removal of CDF for the lagging installation shall proceed in advance of the lagging and shall not begin until the CDF are of sufficient strength that the material remains in place during excavation and lagging installation. If the CDF separates from the soldier pile or caves or spalls from around the soldier pile, the Contractor shall discontinue excavation and lagging installation operations until the CDF is completely set. The bottom of the excavation in front of the wall shall be level. Excavation shall conform to MDT Standard Specifications Section 209, Structure Excavation.
- D. The bottom of excavation shall not be more than 3-feet below the bottom level of the lagging already installed, but in no case shall the depth of excavation beneath the bottom level of installed lagging be such to cause instability of the excavated face. As discussed in Item A, the temporary lagging should be lowered behind the CDF/pile columns as the excavation is taking place to prevent caving. Any caving between the railroad embankment and the temporary shoring that occurs during excavation shall be backfilled with free-draining material as approved by the Engineer.
- E. The lagging shall be installed from the top of the soldier pile proceeding downward. The lagging shall make direct contact with the soil at the base of the wall. When the lagging is in place for each column, the void behind the lagging shall be filled with free-draining gravel backfill as specified above. Contractor shall backfill any settled areas of free-draining gravel with additional free-draining gravel to maintain full pressure against the railroad embankment material.

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 GENERAL**

- A. The following items constitute pay items for the work covered under this section. Payment for these items is full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.
- B. Payment will be made based on the quantity specified in the Proposal unless changes are made to this quantity in accordance with MDT Standard Specifications Section 104.02.3, Significant Changes in the Character of Work, in which case the quantity specified in the Proposal will be adjusted by the amount of the change and will be paid for in accordance with Section 104.02.3.

#### 4.2 SOLDIER PILE SHAFT CONSTRUCTION

- C. Will be measured by the linear foot of shaft excavated below the top of ground line for the shaft, defined as the highest existing ground point within the shaft diameter.
- D. All costs in connection with constructing soldier pile shafts shall be included in the unit Contract price per linear foot, including shaft excavation, temporary casing, installing CDF, and installing the soldier pile assembly.
- E. Payment is made under: AUGER CAST PILING – 2.5 FT – Per Linear Foot.

#### 4.3 FURNISH STEEL PILE

- A. Will be measured by the linear foot of pile assembly specified in the Contract Plans.
- B. All costs in connection with furnishing soldier pile assemblies shall be included in the unit Contract price per linear foot, including fabricating and painting the pile assemblies.
- C. Payment is made under: FURNISH STEEL PILE – Per Linear Foot.

#### 4.4 PRECAST LAGGING

- A. Will be measured by the square foot area of lagging installed. The quantity will be computed based on the vertical dimension from the highest lagging elevation to the lowest lagging elevation between each pair of adjacent soldier piles as the height dimension and the center-to-center spacing of the soldier piles as the length dimension.
- B. All costs in connection with furnishing and installing lagging shall be included in the unit contract price per square foot for “PRECAST CONCRETE LAGGING including removal of CDF for installation of lagging, design of temporary shoring and backfilling voids behind the lagging with a free-draining material as approved by the Engineer.
- C. Payment is made under: PRECAST CONCRETE LAGGING – Per Square Foot.

#### 4.5 STRUCTURE EXCAVATION

- A. Unless otherwise specified, all costs in connection with non-shaft excavation from beginning to end of walls including in front of the existing railroad and highway abutments, including all excavation required for placement of lagging, shall be included in the unit Contract price per cubic yard for STRUCTURE EXCAVATION.

- B. STRUCTURE EXCVATION is measured from the existing ground surface to the bottom of proposed trail base course in Cubic Yards (CY).

**END OF SECTION**

## SECTION 02502

### ASPHALT PRIME AND/OR TACK COAT

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work is the single application of asphalt material as specified in the Contract documents on a prepared subgrade, sub-base, base or asphalt surface meeting the plans and specifications.

#### PART 2: PRODUCTS

##### 2.1 GENERAL

- A. Furnish asphalt material of the grade and type specified below and meeting the requirements of Table 1 and Table 2 in this Section.

<u>Type and Grade</u>	<u>Use</u>
LIQUID ASPHALT, MC-70	Asphalt Prime Coat
EMULSIFIED ASPHALT, SS-1 or SS-1h	Asphalt Tack Coat
EMULSIFIED ASPHALT, CRS-1 OR CRS-2	Asphalt Tack Coat

- B. Furnish Blotter Sand as specified below meeting the requirements of MDT 407.02.2.

1. Blotter material shall be 100% passing the ½-inch (12.5 mm) screen having a PI of 6 or less.

TABLE 1  
SPECIFICATIONS FOR ANIONIC EMULSIFIED ASPHALTS

TYPE	RAPID SETTING				MEDIUM SETTING						SLOW SETTING			
GRADE	RS-1		RS-2		MS-1		MS-2		MS-2h		SS-1		SS-1h	
Test of Emulsions:	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt-Furol at 77EF (25EC)	20	100	...	...	20	100	100	...	100	...	20	100	20	100
Viscosity, Saybolt-Furol at 122EF (50EC)	...	...	75	400	...	...	...	...	...	...	...	...	...	...
Demulsibility*, 35ml, 0.02N CaCl <sup>2</sup> , percent	60	...	60	...	...	...	...	...	...	...	...	...	...	...
Residue by Distillation, percent	55	...	63	...	55	...	65	...	65	...	57	...	57	...
Test on Residue from distillation tests														
Penetration, 77EF (25EC), 100g, 5s	100	200	100	200	100	200	100	20	40	90	100	200	40	90
Ductility, 77EF (25EC), 5cm/min, cm.	40	...	40	...	40	...	40	...	40	...	40	...	40	...
Solubility in Trichloethylene	97.5	...	97.5	...	97.5	...	97.5	...	97.5	...	97.5	...	97.5	...
Suggested Uses:	Surface treatment penetration macadam and tack coat		Surface treatment and penetration macadam		Plant or road mixture with course aggregate, substantially all of which is retained on a No. 8 (2.36 mm) sieve and practically none of which passes a No. 200 (0.075 mm) sieve, tack		Plant or road mixture with course aggregate, substantially all of which is retained on a No. 8 (2.36 mm) sieve and practically none of which passes a No. 200 (0.075 mm) sieve, tack		Plant or road mixture with graded and fine aggregates, substantially quantity of which passes a No. 8 (2.36 mm) sieve and a portion of which may pass a No. 200 (0.075 mm) sieve. Slurry seal treatment.					
*The demulsibility test shall be made within 30 days from the date of shipment.														

TABLE 2  
SPECIFICATIONS FOR CATIONIC EMULSIFIED ASPHALTS - ASSHTO M208

TYPE	RAPID SETTING				MEDIUM SETTING						SLOW SETTING		
GRADE	CRS-1		CRS-2		CMS-1		CMS-2h		CSS-1		CSS-1h		
Test of Emulsions:	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
Viscosity, Saybolt-Furol at 77EF (25EC)	...	...	...	...	...	...	...	...	...	20	100	20	100
Viscosity, Saybolt-Furol at 122EF (50EC)	...	20	100	100	400	50	450	50	450	...	...	...	...
Demulsibility <sup>A</sup> , 35ml, 0.08% sodium dioctyl sultriosuccinate, %	40	...	40	...	...	...	...	...	...	...	...	...	...
Particle Charge Test	Pos	...	Pos	...	Pos	...	Pos	...	Pos <sup>B</sup>	...	...	...	Pos <sup>B</sup>
Distillation:													
Oil distillation by volume of emulsion, percent	...	...	3	...	3	...	12	...	12	...	...	...	...
Residue, percent	60	...	...	65	...	65	...	65	...	...	57	...	57
Test on Residue from distillation tests													
Penetration, 77EF (25EC), 100g, 5s	100	250	100	250	100	250	40	90	100	250	40	90	...
Ductility, 77EF (25EC), 5cm/min, cm.		40	...	40	...	40	...	...	40	...	40	...	40
Solubility in Trichloethylene	97.5	...	...	97.5	...	97.5	...	97.5	...	...	97.5	...	97.5
Suggested Uses:  <sup>A</sup> The demulsibility test shall be made within 30 days from the date of shipment.  <sup>B</sup> If the particle charge test result is inconclusive, material having a maximum pH value of 6.7 will be acceptable.	Surface treatment penetration macadam and tack coat	Surface treatment and penetration macadam	Plant or road mixture with course aggregate, substantially all of which is retained on a No. 8 (2.36 mm) sieve and practically none of which passes a No. 200 (0.075 mm) sieve, tack						Plant or road mixture with graded and fine aggregates, substantially quantity of which passes a No. 8 (2.36 mm) sieve and a portion of which may pass a No. 200 (0.075 mm) sieve. Slurry seal treatment.				

## **PART 3: EXECUTION**

### **3.1 DISTRIBUTORS**

- A. Use a pressure distributor for prime and tack coats that distributes the required amount of asphaltic material at the specified temperature in a uniform spray, without atomization. Assure the distributor is pneumatic tired and does not rut or otherwise damage the surface being sprayed. Equip it with a bitumeter having a dial visible to the truck driver for maintaining the constant speed required for application at the specified rate.
- B. Assure the pump is operated by a separate power unit or by the truck power unit. Equip the pump with tachometer having a dial readily visible to the operator, registering gallons per minutes passing through the nozzles.
- C. The distributor shall be designed so that the normal width of application shall be not less than 12 feet (3.66m), with provision for the application of lesser or greater width when necessary. The distributor shall be designed or equipped so that the height of the spray bar above the surface to be sprayed, may be set and maintained within a tolerance of ½ inch (13 mm) (plus or minus) of the height required to provide a uniform application.
- D. Assure the distributor is equipped and operated so that the asphaltic material is circulated or agitated throughout the entire heating system. Provide a means for constant, accurate temperature indication of the asphaltic material is provided. Assure the thermometer well is placed without contacting the heating tube.

### **3.2 ASPHALT PRIME COAT**

- D. Asphalt prime coat will be applied for use in the Bituminous Surface Treatment as outlined in Section 02520.
- E. Spray the asphalt prime coat, under average conditions, from 0.20 to 0.50 gallons per square yard (0.9 to 8.2 liters per square meter) of low viscosity MC-70 asphalt on the prepared surface of a non-asphaltic base course.
- F. Immediately before applying the prime coat, clean the surface to be primed of all dirt and loose materials using blowers or a power broom, supplemented by hand brooming if necessary. Finish the surface to receive the asphalt material to the specified requirements for smoothness, compaction, and grade . Apply prime coat when the surface is dry or slightly damp and when the air temperature in the shade is not less than 50E F (10EC).
- G. Apply asphalt material using a pressure distributor at the rate or rates directed by the Engineer.

- E. Before spraying, spread building paper over the surface from the joint back, for the distance required for the spray bar to begin spraying and operating at full force when the surface to be treated is reached. Once the asphalt is applied, remove and dispose of the building paper. Assure the spray bar is shut off instantaneously at each construction joint to assure a straight line and full application of asphalt prime up to the joint. If required to prevent dripping, insert a drip pan under the nozzle where the application ends. Use a hand sprayer to apply primer material to touch up all spots missed by the distributor.
- F. Protect the surfaces of structures and trees adjacent to the area being treated from being spattered or marred. Do not discharge asphalt material into borrow pits or gutters.
- G. After the prime coat has been applied, assure it is left undisturbed for at least 24 hours or until it is cured or blotted. Blot all excess asphalt material remaining on the surface after 24 hours with sand before opening the surface to traffic. Maintain the primed or tacked surface until the surfacing has been placed. Maintenance includes spreading any additional sand required to prevent asphalt material adhering to the tires of vehicles using the surface and patching all breaks in the surface with additional bituminous material. Any area of surface disturbed by traffic or otherwise, is to be cleaned before the next course is placed. Before placing the surface course, sweep all excess and/or loose sand used for blotter from the surface.

### 3.3 ASPHALT TACK COAT

- A. The asphalt tack coat is the application of a diluted, slow-breaking, SS-1 or SS-1h asphalt emulsion to insure bond between the surface being paved and the overlying course. Immediately before applying the tack coat, clean the surface to be tacked of all dirt and loose materials using blowers or power brooms, supplemented by hand brooming if necessary.
- B. Apply tack coat when the surface is dry or slightly damp, and when the air temperature in the shade is at least 50°F (10°C).
- C. Dilute the asphalt emulsion, SS-1 or SS-1h, with water at one part emulsion to one part water. Apply the diluted emulsion using a pressure distributor at the rate of 0.1 gallon per square yard (4.5 liters per square meter).
- D. Before application, spread building paper over the surface, from the joint back, for the required distance for the spray bar to begin spraying and operating at full force when the surface to be treated is reached. Once the asphalt is applied, remove and dispose of the building paper. Shut off the spray bar shall instantaneously at each construction joint to assure a straight line and full application of asphalt prime up to the joint. If required to prevent dripping,



insert a drip pan, under the nozzle where the application is stopped. Use a hand sprayer to apply primer material for touching up all spots missed by the distributor.

- E. After the tack coat has been applied, assure it is undisturbed until the asphalt emulsion has “broken”, generally within 30 minutes of application. Place the next paving course after the emulsion has broken.
- F. Schedule operations so that all tack coats are placed with the asphalt paving course in the same day.

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 ASPHALT PRIME COAT**

- A. Asphalt prime coat will not be measured separately. All asphalt prime coat necessary for this project is considered incidental to other pay items. Price and payment for other items is full compensation for all demurrage, storage, handling, and other charges; all material (including the asphalt prime coat material), tools, equipment, labor and performance of all work necessary to the furnishing, testing, delivery, unloading, heating, hauling and spreading of the asphalt prime coat, cleaning the surface to be primed, blotting excess prime material, maintaining the primed surface, and all incidentals necessary to complete the item.

##### **4.2 ASPHALT TACK COAT**

- A. Asphalt tack coat will not be measured separately. All asphalt tack coat necessary for this project is considered incidental to other pay items. Price and payment for other items is full compensation for all demurrage, storage, handling, and other charges; all material (including the asphalt tack coat material and water for diluting), tools, equipment, labor and performance of all work necessary to the furnishing, testing, delivery, unloading, heating, diluting, hauling and spreading of the asphalt tack coat, cleaning the surface to be tacked, maintaining the tacked surface, and all incidentals necessary to complete the item.

**END OF SECTION**

## **SECTION 02504**

### **ASPHALT SEAL COAT**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This work is applying a single application of asphalt material on a prepared asphalt surface, followed by spreading seal coat aggregate meeting these specifications.

##### **1.2 REFERENCES**

AASHTO T11	Amount of Material Finer than No. 200(0.075 mm) Sieve in Aggregate
AASHTO T27	Sieve Analysis of Coarse and Fine Aggregates
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T96	Resistance to Degradation of Aggregate By Abrasion and Impact in the Los Angeles Machine
MT 309	Determining the Percentage of Adhesion of Bituminous Materials to Aggregate
MT 228	Method of Test for Evaluating Cleanness of Cover Coat Material

#### **PART 2: PRODUCTS**

##### **2.1 ASPHALT**

- A. Furnish asphalt material meeting the specifications in Section 02502; ASPHALT PRIME AND/OR TACK COAT and the contract requirements (polymer modified).

##### **2.2 AGGREGATE**

- A. Furnish seal coat aggregate meeting the applicable requirements of Section

02510; ASPHALT CONCRETE PAVEMENT and meeting the applicable table in this section.

- B. Furnish material consisting of crushed stone or crushed aggregate that is clean, durable fragments free from an excess of flat, elongated, soft or disintegrated pieces, clay balls or other deleterious material. Assure the material produced is free from adherent films of clay or rock dust and is washed thoroughly. No combination of shale, clay, coal, or soft particles can exceed 1.5%. Assure the aggregate has a minimum cleanness value of 75 when tested under Montana Test Method MT228.
- C. The material cannot exceed a wear of 40 percent at 500 revolutions when tested under AASHTO Method T96 Grading C. A minimum of 70% by weight of the coarse aggregate (retained on No. 4 Sieve) must have at least one fractured face.
- D. The aggregate, or a composite mixture, must show no detrimental stripping when tested under Montana Test Methods MT-309. If stripping exceeds 5 percent, the aggregate will be rejected or an alternate grade of asphalt substituted to reduce stripping below 5 percent.
- E. For all gradings, that portion of the aggregate passing a No. 40 sieve must be non-plastic as determined by AASHTO T89 and T90.
- F. When tested by AASHTO Methods T11 and T27 in conjunction with water wash, chips must meet the grading requirements of the following table:

### **3/8" SEAL COAT AGGREGATE - TABLE OF GRADATION**

<u>Sieve Designation</u>	<u>Percentage of Weight Passing Sieves</u>
1/2-inch Sieve	100
3/8-inch Sieve	85 - 100
No. 4 Sieve	10 - 30
No. 10 Sieve	0 - 10
No. 40 Sieve	0 - 2

## **PART 3: EXECUTION**

### **3.1 EQUIPMENT**

#### **A. Distributor**

1. Furnish distributors meeting the requirements of Section 02502; ASPHALT PRIME AND/OR TACK COAT.

#### **B. Brooms**

1. Provide power brooms, or a power blower or both.

### **3.2 AGGREGATE SPREADER**

- #### **A.**
- Furnish an independent, self-propelled aggregate spreading equipment (Flaherty Spreadmaster or equal) that can be adjusted to spread the specified quantity of cover aggregate per square yard (square meter).

### **3.3 CONSTRUCTION METHODS:**

#### **A. Seasonal Limitations**

1. Seal coating operations cannot be performed after September 1 for areas higher than 3,500 feet (1,070 meters) above sea level. For areas below 3,500 feet (1,070 meters) above sea level, seal coating operations are not permitted after September 15 unless approved by the Engineer.

#### **B. Weather Limitations**

1. Do not apply asphalt material when the street face is damp or wet, or when the atmospheric temperature in the shade is less than 65E F. (18E C). Do not start work without the Engineer's approval and terminate work at once in event of rain. If rain is forecast, obtain approval from the Engineer before beginning work. Terminate seal coating work just before dark, and stop work during wind that blows sand, dust or other foreign matter into the spread asphalt material before the aggregate is applied.

#### **C. Preparation of Surfaces**

1. General

- a. Do not start coat operations until, the Engineer determines the asphalt surface coarse to be seal coated is thoroughly compacted and rolling and all holes and breaks in the surface and edges are repaired. In no event, unless ordered in writing by the Engineer, is the seal coat to be placed on newly constructed or reconditioned surfaces within 7 days of the surface having been placed.

2. Cleaning

- a. Immediately before applying the asphalt material, clean the surface of all dust, dirt, sand or other objectionable material that prevents complete coverage or bond between the asphalt material and the street surface, using a rotary power broom or blower, by hand sweeping, or both, as required. Thoroughly clean the outer edges adjacent to vertical curbs. Do not mix material removed from the surface with the cover aggregate

3. Temporary reflective lane delineators

- a. Before applying the asphalt material, furnish and install temporary reflective lane delineators to demark vehicle and bike lanes. Place one delineator per stripe at maximum 100 ft stations along the length of the project to receive asphalt seal and chip treatment.

- A. Application of Asphalt Material

1. Application rates will range between 0.20 to 0.35 gallons per square yard (0.9 liters to 1.59 liters per sq. meter) for 1/2", 3/8" and 1/4" (9.5 mm and 6.35 mm) seal coat aggregate or 0.15 to 0.25 gallons per square yard (0.68 liters to 1.13 liters per sq. meter) for sand seal aggregate, depending upon aggregate gradation and asphalt material specified. Apply the asphalt material uniformly at the rate specified.
2. The Engineer may require adjustments in the application during the work. When heating is required, take precautions to avoid fire hazard. Thoroughly clean the distributor before use unless its last use was with the same type of asphaltic material specified for the work.
3. Before application, spread building paper over the surface, from the joint back, for the distance required for the spray bar to begin spraying and operating at full force when it reaches the surface to be treated. After the

asphalt is applied, remove and dispose of the building paper.

4. Shut off the spray bar instantly at each construction joint to assure a straight line and the full application of asphaltic binder up to the joint. If required to prevent dripping, insert a drip pan under the nozzles when the application is stopped.
5. Use a hand sprayer to apply asphaltic binder to touch up all spots missed by the distributor.
6. Before and during seal coating operations, calibrate or check the adjustments on the distributor as follows:
  - a. Tank calibration
  - b. Nozzle adjustment and pressure
  - c. Spray bar height
  - d. Bitumeter calibration
  - e. Transverse and Longitudinal Spread of Asphalt Material
    - 1) Transverse spread variation shall not exceed 15 percent
    - 2) longitudinal spread variation shall not exceed 10 percent plus or minus of the rate specified

E. Application of Seal Coat Material

1. This rate will range between 20 to 30 pounds per square yard (10 to 16 kg/sq. meter) for 1/2" and 3/8" aggregate, 15 to 25 pounds per square yard (8 to 13.5 kg per square meter) for 1/4" aggregate, or 10 to 15 pounds per square yard (5.5 to 8 kg per square meter) for sand seal coat aggregate, depending on aggregate gradation. During the course of the work, adjustments will be made in the rate of application when required.
2. Assure the cover coat material is stockpiled enough in advance of the work so that excess water has drained from the aggregate. Do not spread seal coat aggregate if the moisture content of the aggregate exceeds 2 percent.
3. Uniformly distribute the cover coat at the specified rate using a mechanical or a self-propelled spreader immediately after the asphaltic material application. If weather or surface conditions make, require, restrict the application of asphalt material to the area coverable by the cover coat

material available in the trucks. Assure cover aggregate is available at all times to assure continuous seal coating operations. Do not apply seal coat aggregate to cold, dried or partially dried asphalt material.

4. Immediately after spreading, roll the aggregate with self-propelled, pneumatic-tired rollers. Roll in a longitudinal direction, beginning at the outer edges of the treatment and working toward the center. Overlap the previous strip by about one-half the roller width. Complete the first rolling of the aggregate within one-half hour of it being spread. Continue rolling until a smooth, thoroughly compacted surface is obtained. Roll at least three complete passes with each roller. If the seal coat is finished in partial widths at a time, leave 4 to 6 inches (100 mm to 150 mm) of the inside edge uncovered with aggregate to permit overlap of asphaltic material when the remaining portion of the surface is treated.
5. Remove all loose aggregate from the pavement after the work is completed, and dispose of at the specified location. If a location is not designated, the chips become the Contractor's property.

#### 3.4 PROTECTION OF STREET SIDE STRUCTURES AND TRAFFIC CONTROL:

- A. Protect all sign posts, street lamp posts, trees, shrubs and tops of curbs and gutters from splashing asphaltic material. Compensation for furnishing, erecting and removing such protection is included in the unit price bid for the application of asphalt material.
- B. Keep traffic off of freshly sprayed asphalt.

#### 3.5 WARRANTY

- A. The asphalt seal coat will have a 60-calendar day warranty period that will be independent of the project warranty period. If the asphalt seal coat experiences chip loss, tracking, flushing or bleeding at any time within 60 calendar days of seal coat completion, perform repairs to the seal coat at no additional cost to the Owner. When repairs are deemed necessary, reference is made to the "MDT Seal Coat Warranty Administration Guide." Submit a detailed repair plan for approval. Make warranty repairs in accordance with the provisions of this specification. When performing warranty work, furnish traffic control meeting MUTCD requirements at no additional cost to the Owner. If this work cannot be completed by the completion of the contract, within the requirements of this section, the warranty periods for the project and warranty period for the asphalt seal coat shall be enforced independently. Any additional cost incurred for not

meeting the contract completions date, to include additional temporary paint and additional traffic control, shall be the contractor's responsibility.

**PART 4: MEASUREMENT AND PAYMENT**

**4.1 ASPHALT SEAL COAT**

- A. Measure asphalt seal coat by the square foot in its final position. Payment for asphalt seal coat will be according to the designed quantity as shown in the bid schedule unless it is determined by the Contractor and verified by the Engineer that errors exist in the original design that cause the pay item quantity to change by 10 percent or more. Payment will be full compensation for the work prescribed in this Section.

**END OF SECTION**



## SECTION 02510

### ASPHALT CONCRETE PAVEMENT

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work is the production and placement of plant mix asphalt concrete pavement.
- B. Hot plant mix asphalt concrete is a mineral aggregate and asphalt material mixed at a central hot plant meeting these specifications and placed in one or more courses on a newly prepared or existing street roadway in accordance with the contract documents.

##### 1.2 REFERENCES

AASHTO T11 (ASTM D1140)	Amount of Material Finer than No. 200 (0.075 mm) Sieve in Aggregate
ASTM D5361	Standard Practice for Sampling Compacted Bituminous Mixtures for Laboratory Testing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89 (ASTM D4318)	Determining Liquid Limit of Soils
AASHTO T90 (ASTM D4318)	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T283 (ASTM D4867)	Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage
AASHTO T176 (ASTM D2419)	Sand Equivalent Value of Soils and Fine Aggregate
AASHTO T245 (ASTM D6926, D6927)	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
AASHTO T96 (ASTM C131)	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D2041	Theoretical Maximum Specific Gravity and Density of Bituminous Mixtures
ASTM C1097	Hydrated Lime for Use in Asphaltic Concrete Mixtures
ASTM D3666	Evaluating and Qualifying Agencies Testing and Inspecting
ASTM D5821	Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM C123	Lightweight Particles in Aggregate
ASTM D6307	Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTMC142	Clay Lumps and Friable Particles in Aggregates
MS-2	Asphalt Institute - Mix Design Methods

## **PART 2: PRODUCTS**

### **2.1 GENERAL**

- A. The Asphalt Concrete Base Course must have at least a 3-bin separation, when continuous flow mixing types of plants are used. When a drum dryer is used with a weight batching system from dry bins, separate and stockpile the crushed aggregate into two sizes.
- B. The specific type and grading of aggregate shall be consistent with those used on other local, state, or federal projects with similar type construction as is outlined for this project. Submit proposed aggregate gradation to the Engineer for approval. Aggregate types and grades are described in this specification.
- C. The furnishing of asphalt materials for use in asphaltic concrete mixes shall meet the requirements for the particular grade specified in the contract documents. The types and grades are described in this specification.
- D. Prepare pavement course to conform to the lines, grades, thickness and typical cross sections shown in project documents and plans, and shall be rolled, finished, and approved by the Engineer before the placement of the next course.

### **2.2 PLANT MIX AGGREGATES**

- A. Furnish aggregates from acceptable sources approved by the Engineer.
- B. Furnish test data as outlined in this section on each source to be used for acceptance by the Engineer.
- C. Designation of the sources of supply and the acceptability of the material therefrom, does not extend to the grading of the material as it may naturally come from the pit or crusher. Adjust the crusher and screens to remove certain portions of the material as may be necessary to furnish gravel that will comply with the specifications in the contract. No additional compensation will be allowed for such adjustment of the equipment or the rejection of waste. It is understood that the Engineer may order procurement of material from any portion of any area designated as a pit site and may reject portions of the deposit as unacceptable.
- D. Aggregate materials shall not contain more than 1.5% by weight of clay lumps, shale, or coal, nor lightweight particles shall exceed 3.5% by weight. No combination of clay, shale, coal, or lightweight particles shall exceed 3.5% by weight. Do not use Scoria (fired clay). Aggregate materials shall conform to the grading stipulated in the contract documents. Use reasonable care in the selection of material in a pit so that uniform product will be produced at all times. No compensation will be allowed for such stripping of the pit as may be required in

order that satisfactory material may be secured.

- E. Aggregate used shall consist of gravel, crushed to the specified size, crushed stone, composed of hard durable pebbles or stone fragments, reclaimed asphalt pavement, and finely crushed stone filler, sand or natural clean material, or other fine mineral material. The portion of the material retained on the No. 4 sieve (4.74 mm) will be called coarse aggregate and that passing the No. 4 sieve (4.74 mm) and retained on the #200 sieve (0.075) will be called fine aggregate. The material passing the #200 (0.075 mm) will be called mineral filler. The reclaimed asphalt pavement shall be removed from its original location and reduced by suitable means to such particle size as may be required for use in hot plant mix asphalt concrete.
- F. For all gradings of fine aggregate, including any blended fine aggregate and mineral filler, passing a No. 40 sieve (0.425 mm), shall have a liquid limit not exceeding 25 and a plasticity index of not more than 6.
- G. Produce coarse aggregate retained on the No. 4 sieve (4.74 mm) having a minimum of 50% by weight of particles with at least one mechanically fractured face. The coarse aggregate shall not exceed 40% wear at 500 revolutions.
- H. Preliminary acceptance of aggregates proposed for use may be made at the point of production. Final acceptance will be made only after tests of the aggregates are complete and in place.
- I. Surface Course Asphalt Plant Mix Aggregate:

**TABLE 1**

**REQUIREMENTS FOR GRADING OF SURFACE COURSE AGGREGATE**

Percentage by Weight Passing Job Mix Target Bands						
Sieve Size	Type A	Type B		Type C		Job Mix Tolerance
1" (25.0 mm)	100	...		...		...
3/4" (19.0 mm)	91-93	100		...		± 7
1/2" (12.5 mm)	76-89	83-93		100		± 7
3/8" (9.5 mm)	61-79	73-87		91-93		± 7
No. 4 (4.75mm)	41-54	47-63		51-71		± 6
No. 10 (2.00 mm)	31-39	32-43		34-46		± 6
No. 40 (0.425mm)	16-27	15-25		16-26		± 5
No. 200 (0.075 mm)	4-7	5-7		5-9		± 2

1. The above gradation bands represent the job mix target limits, which

determine the suitability of aggregate for use. The final job mix target gradation must be within the specified bands and uniformly graded from coarse to fine and not vary from the low limits on one screen to the high limits on the adjacent screen, or vice versa. The final job mix gradation limits are established by applying the job mix tolerances to the job mix targets.

2. The job mix formula establishes target values. During production of the mix, the target gradation shall lie within the job mix grading limits specified in Table 1. For example, "Type A, No. 200" band is "4-7". QA job mix target of 5 has been selected for the final mix. The job mix gradation limits is 5, plus and minus 2. Therefore, the job mix gradation limits for production is 3-7.

## 2.3 ASPHALT BINDER MATERIAL

- A. Furnish Asphalt binder material to be used as specified in the contract documents that meet the type and grade specified requirements in this section in Table 3.
  1. Grades:
    - a. (PGAB) PG 58-22
    - b. (PGAB) PG 58-28
    - c. (PGAB) PG 64-22
    - d. (PGAB) PG 64-28 (Polymer Modified)
- B. The percentage of asphalt by weight, to be added to the aggregate will be, generally, between 4 and 8 percent of the weight of the total mix. The mix design will establish the exact percentage of asphalt in the mix, based upon preliminary laboratory tests, sieve analysis and grading and character of the aggregate furnished within the specification limits. No claim is allowed for the payment for rejecting any batch or load of mixture containing an excess or deficient amount of asphalt binder varying more than 0.4 of a percent from the fixed mix design percentage.
- C. Obtain Engineer approval of the asphalt material source before shipments are made to any project. The source of supply cannot change after work is started unless approved in writing by the Engineer. The Engineer is not liable for the quantity shipped.
- D. Samples of asphalt binder material may be taken, as directed by the Engineer, and placed in uncontaminated one-quart containers. When sampled, these shall be taken from the tanker car or truck at the point of delivery on the project and submitted to the Engineer.
- E. All transport vehicles must be equipped with a spigot or gate valve installed in either: (1) the unloading line, (2) in the tanker at the centerline on the tank, (3) in

the pressure line from the unloading pump, or other locations approved by the Engineer. Assure the spigot or gate valve has a diameter of between 3/8 inch (1 cm) and 3/4 inch (2.5 cm). The spigot valve must be located to prevent contamination from plant dust or other contaminants.

- F. The supplier furnishing the asphalt binder material shall inspect each tanker car or truck before it is loaded and ship only in clean, uncontaminated, fully insulated cars or trucks, sealed after loading by the supplier.
- G. The material supplier shall issue, in duplicate, a certificate showing full compliance with the specifications for the designated grade of material, together with the following information. Project number, date of shipment, source of the material, car or truck initial and number, destination, gross quantity loaded, loading temperature, and net quantity in gallons at 60EF (15.5E C) or tons, whichever unit of measurement is stipulated. Assure the certificate of compliance accompanies the shipment and is furnished to the Engineer. The certificate, signed by the supplier representative, must also certify that the conveyance vessel was inspected and found to be free of contaminating material.
- H. The certificate of compliance is the basis for tentative acceptance and use of the material. Samples taken according to applicable sampling methods and retained by the Engineer may be tested at the Engineer's discretion. Failure of the asphalt material to meet these specifications may result in rejection of the entire, associated work. If rejected, remove and replace rejected work.
- I. Apply asphalt material at temperatures that assure uniform mixing or spreading. Application temperature ranges for each grade of material should be accompanied with the mix design. Application temperature for mixing applications will be in accordance with the mix design.
- J. Upon request by the Engineer, furnish the Engineer and/or laboratory (responsible for completing the mix design) with data or a report showing the temperature-viscosity relationship of each asphalt binder used on the project. Assure this data covers the range of temperatures used for mixing and compaction. In addition, the Engineer may request a complete set of test results from Table 3 for each grade used on the project.

**TABLE 3****PERFORMANCE GRADED ASPHALT BINDER (PGAB)**

Performance Grade	PG 58		PG 64		Test Methods
	-22	-28	-22	-28	
Average 7-day Maximum Pavement Design Temperature, EC	<58		<64		
Minimum Pavement Design Temperature, EC	>-22	>-28	>-22	>-28	
Original Binder					
Flash Point Temp.: Minimum EC	230				AASHTO T48
Viscosity: Maximum, 3 Pa $\cdot$ s (3000 cP), Test Temp, EC	135				ASTM D4402
Dynamic Shear: G* / sin delta, Minimum, 1.00 kPa Test Temp @ 10 rad / s, EC	58		64		AASHTO TP5
Rolling Thin Film Oven (AASHTO T240) or Thin Film Oven (T179) Residue					
Mass Loss, Maximum, %	1.0				AASHTO T240
Dynamic Shear: G* / sin delta, Minimum, 2.20 kPa Test Temp @ 10 rad / s, EC	58		64		AASHTO TP5
Pressure Aging Vessel Residue (AASHTO PP1)					
PAV Aging Temp, EC	100		100		AASHTO PP1
Dynamic Shear: G* / sin delta, Minimum, 5000 kPa Test Temp @ 10 rad / s, EC	22	19	25	22	AASHTO TP5
Creep Stiffness <sup>a</sup> : S, Minimum, 300 MPa m-value, Minimum, 0.300 Test Temp, @ 60 sec, EC	-12	-18	-12	-18	AASHTO TP1
Direct Tension <sup>a</sup> : Failure Strain, Minimum, 1.0%, Test Temp @ 1.0 mm/min, EC	-12	-18	-12	-18	AASHTO TP3

- a. If creep stiffness is below 300 MPa, the direct tension test is not required. If the creep stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used in lieu of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

## 2.4 HYDRATED LIME FOR ASPHALT CONCRETE

- A. Mineral filler may be incorporated in the asphalt concrete mixture. Furnish hydrated lime as filler when specified. Assure it is free of lumps and extraneous material and meets the following gradation requirements as per ASTM D242:

<u>Sieve</u>	<u>Percent Passing</u>
No. 30 (0.60 mm) Sieve	100
No. 80 (0.180 mm) Sieve	95-100
No. 200 (0.075 mm) Sieve	70-100

- B. Assure the hydrated lime meets paragraph 2 (chemical composition) and paragraph 7 (a) requirements (chemical analysis) of ASTM C1097.
- C. Where required, the mineral filler will be effectively mixed with the hot plant mix asphaltic concrete.

## 2.5 COMPOSITION OF MIXES:

- A. General
1. Submit to the engineer for approval a mix design for each mix required on the project. Assure the job-mix formula is within the gradation limits in Part 2 Products in this Section.
  2. Have the job-mix formula prepared by an independent testing laboratory approved by the Engineer. The requirements of ASTM D-3666 are the guidelines for testing laboratory approval. The cost of the job-mix formula(s) is at Contractor expense.
  3. Keep the job mix formula current and contain the following minimum information:
    - a. Gradation of all constituent aggregates.
    - b. Specific gravity of constituent aggregates and asphalt cement.
    - c. Source of supply of all materials and grade of asphalt cement.
    - d. Marshall design curves for stability, unit weight, flow and volumetric requirements (VMA and total voids) at asphalt contents below and above optimum (four points minimum).
    - e. Measured voidless (Rice's) specific gravity used in voids computations.
    - f. Composite aggregate grading.
    - g. Recommended asphalt cement content.
    - h. Marshall compactive effort (50 blows).
    - i. Date of mix design (job mix formula).
    - j. Index of retained strength.

4. In addition to the job mix formula, all asphalt concrete surfacing mix submittals will have laboratory tests indicating that the Tensile Strength Ratio (TSR) as determined by AASHTO T-283, is at least 70%. Test shall be performed at 7.0 +/- 1% air voids and shall include the freeze cycle.

**B. Asphalt Concrete Surface Course**

1. The maximum permissible variation from the job-mix formula within the specification limits is as follows:
  - a. Aggregate Gradation..... Within Job Mix Tolerances
  - b. Asphalt .....  $\pm 0.4$  percent\*
  - c. Temperature of Mix .....  $\pm 20^{\circ}$  F

\* This tolerance will be permitted only if the job mix parameter curves indicate that the corresponding Marshall design limits are not exceeded.
2. Produce Hot Plant Mix Asphalt Concrete Base Courses having the following characteristics as measured by AASHTO T245, ASTM D6726 & D6927 “Resistance to Plastic Flow of Bituminous Mixtures by means of the Marshall Apparatus”:
  - a. Number of compaction blows, each end of specimen.....50
  - b. Stability, minimum .....1200
  - c. Flow..... 8 - 18
  - d. Air voids, percent..... 3 - 5
  - e. Percent voids in mineral aggregate (minimum) .....See Table 4

<b>TABLE 4</b>	
<b>REQUIRED VOIDS IN MINERAL AGGREGATE (VMA)</b>	
Nominal particle size (table 2)	Voids in Mineral Aggregate, Min.
3/8 - inch (9.5 mm)	14
1/2 - inch (12.5 mm)	13
3/4 - inch (19.0 mm)	12
1 - inch (25.0 mm)	11
1 1/2 - inch (37.5 mm)	10
Nominal maximum particle size is one size larger than the first sieve to retain more than 10 percent.	



## **PART 3: EXECUTION**

### **3.1 CRUSHING:**

#### **A. Crushing Equipment**

1. Fit crushing plant-screening equipment, when required, with blowers or other devices capable of removing excess and undesirable fines.

#### **B. Screening Plants**

1. Screening plants consist of a revolving trommel screen, shaker screen, vibrating screen, or other devices capable of removing oversize material, excess and undesirable fines.

#### **C. Scales**

1. Furnish scales, when required, satisfactory to the Engineer. Test and certify scales prior to their use on the project and as often thereafter as the Engineer may consider necessary to insure their accuracy. Have on hand not less than ten, 50-pound weights for testing scales.
2. House the recording devices of the scales in a suitable manner. Place the scales in a location suitable to facilitate accurate weighing of loads. The scales shall be accurate to one-half of one percent at any weight. Alternate methods or devices for weighing may be acceptable, provided that these methods or devices produce the same degree of accuracy as required of platform scales.

### **3.2 MATERIAL HANDLING:**

- A. All work involved in clearing and stripping pits and quarries, including handling unsuitable material encountered, are performed with no additional compensation being allowed for this work. The pits as utilized shall immediately be opened so as to expose the vertical faces of the various strata of acceptable material and, unless otherwise directed, the material shall be secured in successive vertical cuts extending through all the exposed strata.
- B. Provide, unless otherwise specified, material containing as large a proportion as possible of crushed aggregate. Combine the crushed material with the screened material to obtain a uniform product.
- C. No material will be accepted which is loaded into hauling units in a segregated condition or which does not meet the required grading. In case the material deposit contains sand or other material in excess of the specification gradation requirements, or of an unacceptable quality, such excess or undesirable material

shall be removed and disposed of prior to crushing, or during screening operations, if crushing is not required.

- D. Provide a storage bin of ample capacity to insure uniform quality and delivery of material. Loading of trucks directly from the conveyor belt, from the crusher or screening plant will not be permitted.

### 3.3 STOCKPILES:

- A. Grub and clean sites for aggregate stockpiles prior to storing aggregates. Assure the site is firm, smooth and well drained. Maintain a bed of aggregate suitable to avoid the inclusion of soil or foreign material.
- B. Build up coarse aggregate stockpiles in tiers of not more than 4 feet (1.2 m) in thickness. Assure each tier is completely in place before the next tier is placed. Do not allow material to “cone” down over the next lower tier.
- C. Dumping, casting or pushing over the sides of stockpiles will be prohibited, except in the case of the fine aggregate stockpiles.
- D. Space stockpiles of different gradations of aggregate far enough apart, or separated by suitable walls or partitions, to prevent the mixing of the aggregates.
- E. Any methods of stockpiling aggregate, which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the aggregate, will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has operated and failure of such samples to meet all grading requirements for the aggregate discontinuance of such stockpiling procedures.
- F. Transfer the aggregate from the stockpiles in such a manner that uniform grading of the material is preserved.

### 3.4 CONVEYOR STOCKPILING:

- A. Materials stockpiled by conveyors shall be deposited in a succession of merging-cone piles. Do not drop material over 12 feet (3.66m) nor allow cones to exceed 12 feet (3.66m) in height. Cones should be leveled to a thickness of approximately 4 feet (1.2m) prior to starting another tier.

### 3.5 TRUCK STOCKPILING:

- A. Materials stockpiled by trucks shall construct the stockpile in tiers approximately 4 feet (1.2m) in thickness. Complete each tier before the next tier is started.

### 3.6 ASPHALT MIXING PLANTS

- A. Use mixing plants of either the weight batching type, the continuous flow mixing type, or drum dryer type. Use drum dryer mixers specifically designed and constructed for producing hot mix.
- B. Equip all plants with approved conveyors, power units, aggregate handling equipment, aggregate screens and bins that are coordinated and operated to produce a uniform mixture within the specified job mix tolerances.
- C. Use batch-type plants having a minimum batch production capacity of 2,000 pounds (900 kg). Use continuous flow or drum dryer plants having a minimum production capacity of 60 tons per hour (27 kg per hour). These capacity requirements may be modified if specified in the Contract Documents.
- D. Stop production and remove from the project mixing plants that fail to continuously produce a mixture meeting requirements as specified.

### 3.7 INSPECTION AND CONTROL OF ASPHALT MIXING PLANT:

- A. For verification of weights and measures, character of materials and determination of temperatures used in the preparation of the paving mixes, the Engineer or his authorized representatives will, at all times, have access to all portions of the mixing plant, aggregate plant, storage yards and other facilities for producing and processing the materials for the work. All sampling and testing of processed and unprocessed material is performed in accordance with the provisions of the Contract Documents.

### 3.8 MIX DESIGN:

- A. The Contractor's independent testing agency shall provide the engineer with a gradation analysis of the completed mix to assure that the materials being produced and used are within the tolerances of the mix design and the specifications of the mix being used.

### 3.9 SAMPLING AND TESTING FOR ACCEPTANCE:

- A. Sampling and testing of aggregates or other constituent materials will be performed by the independent testing agency at a frequency determined by the owner or the owner's representative. Marshall field control is performed under AASHTO T245, ASTM D6926 & D6927. Field density testing is by core testing for acceptance purposes. Densities to conform to Section 2510, 3.28. Gradations to be within the job mix gradation limits. Oil content to be within 0.4 percent of the Marshall Mix Design.
- B. Samples will be used to verify compliance with the requirements set forth in this Section. If there is a dispute, a third party testing firm may be retained by the

Contractor for additional testing.

**3.10 WEATHER LIMITATIONS:**

- A. When the moisture in the stockpiled aggregate or the dryer adversely effects the quality of mix production, normal plant operations, or when pools of water are observed on the base, mixing and placing of hot-mix asphalt is prohibited.
- B. Do not place asphalt hot-mix surface course mixture when the air temperature is less than 40°F (4°C) and rising. Do not place asphalt hot-mix base course mixtures of compacted lifts 4 inches (10 cm) or more when the air temperature is less than 30°F (-1°C) and rising. Do not place asphalt upon a surface which is frozen or that has a temperature of less than 32°F (0°C). Do not place paving during rainfall or in standing water.

**3.11 SURFACE PREPARATION:**

- A. Assure the area to be paved is true to line and grade and has a dry and properly prepared surface before starting paving operations. Assure the surface is free from all loose screenings and other loose or foreign material.

**3.12 NEW WORK:**

- A. For new work, meet the surface preparation requirements in Sections 02230, 02234 or 02235 of these specifications. Prime prepared soil or aggregate bases if indicated as a bid item in the Contract Documents.
- B. Before paving, proof-roll the base with equipment having at least one 18 kip single axle load or equivalent. Excavate and replace areas that yield or crack under these wheel loads as directed. This does not replace or relax the base or subgrade compaction requirements.
- C. Paint the surfaces of curbs and gutters, vertical faces of existing pavements and all structures in contact with asphalt mixes with a thin coating of asphaltic material to provide a water-tight joint.

**3.13 OVERLAYS OVER EXISTING PAVEMENTS AND OLD BASE:**

- A. Where a base is rough or uneven, place a leveling course using a paver or motor grader and compact before the placing of subsequent courses.
- B. When specified, place construction fabric to control reflective cracking, as detailed, meeting Section 02110.3.4 Pavement Overlay Applications.
- C. When a leveling course is not specified, patch or correct all depressions and other irregularities, subject to the Engineer's approval, before starting other paving operations. Remove all rich and unsuitable patches, excess crack or joint filler,

and all surplus bitumen from the area to be paved. Do not blot excessive deposits of asphalt with sand or stone.

- D. Apply a tack coat when the surface to be paved is an existing Portland cement concrete, brick or asphalt pavement. When a tack coat is required, use the asphalt material indicated, at the rate specified in Section 02502.
- E. Coat the surfaces of curbs and gutters, vertical faces of existing pavements and all structures in actual contact with asphalt mixes with a thin, complete coating of asphalt material to provide a water-tight joint.

### 3.14 PATCHING:

#### A. Weather Limitations

- 1. Follow procedures set out in Section 3.10.

#### B. Surface Preparations

- 1. Assure the area to be paved is true to line and grade, is dry and properly prepared surface before starting paving operations. Clean the surface of all loose screenings and other loose or foreign material.
- 2. Before paving, proof roll the base. Areas that yield excessively or crack under such wheel loads will be excavated and replaced, to correct yielding and cracking problems. This does not replace the base or subgrade compaction requirements. Cut the edge of existing pavements against which additional pavement is to be placed straight and vertical.
- 3. Minimum standards for patching new or existing pavement include the following:
  - a. Neatly cut all asphalt edges using an asphalt saw.
  - b. Cut asphalt edges to form as regular a patch shape as practical and should, in general, approximate a rectangle.
  - c. Cut asphalt edges at least 30 cm (12 inches) wider than the trench width on each side of trench excavations; and, in general, be cut parallel to the street centerline for mainline construction and perpendicular to the street centerline for service lateral construction.
- 4. Remove and replace asphalt surface widths of less than 3 feet (90 cm).

#### C. Compaction

1. Compact to a density equal to or greater than 92 percent of Maximum Theoretical Density (RICE) as determined by ASTM D2041.

### 3.15 TRANSPORTATION OF MIX:

- A. Transport the mix in vehicles cleaned of all foreign material which may affect the mix. The truck beds must be painted, or sprayed with a lime-water, soap or detergent solution at least once a day or as often as required. After this operation, elevate the truck bed and thoroughly drain it, with no excess solution being permitted. Dispatch the vehicles so that all material delivered is placed in daylight, unless the Engineer approves artificial light. Deliver material to the paver at a uniform rate and in amount well within the capacity of the paving and compacting equipment.

### 3.16 SPREADING AND FINISHING:

- A. Spread and finish meeting the following requirements
  1. The maximum lift thickness is 2 ½ inches (6.5 cm) for surface courses and 5 inches (13 cm) for base courses.

### 3.17 MECHANICAL PAVERS:

- A. Spread and strike off the base and surface courses with a mechanical paving machine. Operate the paving machine so that material does not accumulate and remain along the sides of the receiving hopper.
- B. Do not use equipment, which leaves tracks or indented areas, which cannot be corrected in normal operation, produces flushing or other permanent blemishes, or fails to produce a satisfactory surface.
- C. Construct longitudinal joints and edges to true line markings. Establish lines for the paver to follow in placing individual lanes parallel to the centerline of the proposed roadway. Position and operate the paver to follow closely the established lines.
- D. When using pavers in echelon, assure the first paver follows the marks or lines with the second paver following the edge of the material placed by the first paver. To assure a hot joint and obtain proper compaction, assure the pavers work as close together as possible, not exceeding 100 feet (30 m) apart. In backing trucks against the paver, take care not to jar the paver out of its proper alignment.
- E. As soon as the first load of material has been spread, check the texture of the unrolled surface to determine its uniformity. Segregation of materials is not permitted. If segregation occurs, suspend spreading operation until the cause is determined and corrected.

- F. Offset transverse joints in succeeding courses at least 2 feet (0.6 m). Offset longitudinal joints at least 6 inches (15 cm).
- G. Correct all irregularities in alignment left by the paver by trimming directly behind the machine. Immediately after trimming, thoroughly compact the edges of the course by tamping. Avoid distorting the pavement during this operation.
- H. Assure edges against which additional pavement is to be placed is straight and approximately vertical. Use a lute or covered rake immediately behind the paver, when required, to obtain a true line and vertical edge. Correct all irregularities in the surface of the pavement course directly behind the paver. Remove excess material forming high spots by a shovel or lute. Fill low areas with hot mix and smooth it with the back of a shovel being pulled over the surface. Fanning of material over such areas is not permitted.

### 3.18 MOTOR GRADER:

- A. When motor graders are used for the spreading of leveling courses, place the material on the roadbed so that the proper amount of material is available. Spread the mix to the required thickness, line and grade, with a uniform surface texture, while at a workable temperature.

### 3.19 HAND SPREADING:

- A. In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand, if so directed by the Engineer. Wood or steel forms, approved by the Engineer, rigidly supported to assure correct grade and cross section, may be used. In such instances, measuring blocks and intermediate strips must be used to obtain the required cross-section. Perform hand placing carefully. Uniformly distribute the material to avoid segregation of the coarse and fine aggregate. Broadcasting of material is not permitted. During the spreading operation, loosen and uniformly distribute all material using lutes or covered rakes. Reject material that has formed into lumps and does not break down readily. Following placing and before rolling, check the surface with templates and straightedges and correct all irregularities.
- B. Maintain on the project heating equipment for keeping hand tools free from asphalt. Exercise caution to prevent heating that may burn the material. Assure the temperature of the tools when used is not greater than the temperature of the mix being placed. Use heat only to clean hand tools; petroleum oils or solvents are not permitted.

### 3.20 COMPACTION:

- A. Furnish the number of rollers necessary to provide the specified pavement density. During rolling, keep the roller wheels moist to avoid picking up the

material.

- B. After the longitudinal joints and edges have been compacted, start rolling longitudinally at the sides and progress toward the center of the pavement. For transverse graded streets, begin rolling on the low side and progress to the high side, overlapping passes by at least one-half the width of rollers and uniformly lapping each preceding pass. Operate the rollers at a slow, uniform speed with the drive roll or wheel nearest the paver. Do not exceed 3 miles per hour (4.8 km per hour).
- C. Do not quickly change the line of rolling reversing direction suddenly. If rolling displaces the material, re-work the area using lutes or shovels and restore it the original grade of the loose material before re-rolling. Do not permit heavy equipment or rollers to stand on the finished surface before it has been compacted and has thoroughly cooled.
- D. When paving in single width, roll the first lane placed as follows:
  - 1. Transverse joints
  - 2. Outside edge
  - 3. Initial or breakdown rolling, beginning on the low side and progressing toward the high side.
  - 4. Second rolling, same procedures as 3
  - 5. Finish rolling
- E. When paving in echelon, or abutting a previously placed lane, perform the longitudinal joint rolling the same as transverse joint rolling.
- F. When paving in echelon, leave 2 or 3 inches (5 to 7.5 cm) of the edge unrolled, which the second paver can match unrolled. Then the joint between the lanes can be rolled together. Do not leave edges exposed more than 15 minutes without being rolled.
- G. In laying a surface mix adjacent to any finished area, place it high enough so that, when compacted, the finished surface is true and uniform.
- H. On slight grades, check gutters with a straightedge and test with running water to assure drainage to the planned outlet.
- I. The average density shall be equal to or greater than 93 percent of the maximum density as determined by ASTM D2041 and no individual sample shall be less than 92 percent of maximum density.

### 3.21 TRANSVERSE JOINTS:

- A. Construct and compact transverse joints to provide a smooth riding surface. Joints will be straight edged and string lined to assure smoothness and true alignment.



- B. Joint formed with bulkheads to provide a straight line and vertical face will be checked with a straightedge before fresh material is placed against it to complete the joint. If bulkheads are not used to form the joint and the roller is permitted to roll over the edge of the new material, locate the joint line in back of the rounded edge the distance required to provide a true surface and cross-section. If a joint has been distorted by traffic or by other causes, trim it to line. Paint the joint face with a thin coating of asphalt before the fresh material is placed against it.
- C. Place the material against the joints vertical face with the paving machine positioned so that the material overlaps the edge of the joint 1 to 2 inches (2.5 to 5 cm). Maintain a uniform depth of the overlapped material. Remove and dispose of the coarse aggregate in the overlapped material that dislodged during raking.
- D. Position rollers on the previously compacted material transversely so that no more than 6 inches (15 cm) of the rolling wheel rides on the edge of the joint. Operate the roller to pinch and press the mix into place at the transverse joint. Continue rolling along this line, shifting position gradually across the joint, in 6 to 8-inch (15 to 20 cm) increments, until the joint has been rolled by entire width of the roller wheel.
- E. Keep the number of transverse joints to a minimum. When paving single width and maintaining traffic, pave one lane no farther than one block. Complete all lanes to the same station at the end of each paving day. When paving in echelon, bring the lanes up even as is practical.

### 3.22 LONGITUDINAL JOINTS:

- A. Roll longitudinal joints directly behind the paving operation. Assure the first lane placed is true to line and grade and has a vertical face. Place the material in the lane being paved up firmly against the face of the previously placed lane. Position the paver during spreading to assure the material overlaps the edge of the lane previously placed by 1 inch to 2 inches (25 to 50 mm). Uniformly maintain the width and depth of the overlapped material at all times. Keep the paver aligned with the line or markings placed along the joint for alignment purposes. Before rolling, remove and dispose of the coarse aggregate in the material overlapping the joint.
- B. Shift rollers onto the previously placed lane so that not more than 6 inches (15 cm) of the roller wheel rides on the edge of the fine material left by brooming. Operate the rollers to compact the fines gradually across the joint. Continue rolling until a compacted, neat joint is obtained. When the abutting lane is not placed in the same day, paint the joint with a very thin coating of asphalt before placing the abutting lane. If the joint is distorted during the day's work by traffic or by other causes, carefully trim the edge of the lane to a neat line.

### 3.23 EDGES:

- A. Roll the pavement edges concurrently with or immediately after rolling the longitudinal joint.
- B. Exercise care in consolidating the course along the entire length of the edges. In rolling pavement edges, extend the roller wheels 2 to 4 inches (5 to 10 cm) beyond the pavement edge.

### 3.24 BREAKDOWN ROLLING:

- A. Immediately begin breakdown rolling following the rolling of the longitudinal joint edges. Operate rollers as close to the paver as required to obtain density without causing undue displacement. Operate the breakdown roller with the drive roll or wheel nearest the finishing machine. The Engineer may make exceptions when working on steep slopes or super-elevated curves.

### 3.25 SECOND ROLLING:

- A. Assure the second rolling follows the breakdown rolling as close as possible while the paving mix is still at a temperature that will provide the specified density.

### 3.26 FINISH ROLLING:

- A. Perform the finish rolling while the material is still warm enough to remove roller marks. If necessary, the Engineer may require using pneumatic-tired rollers. Complete finish rolling the same day the mixture is placed.
- B. In places inaccessible to standard rollers, perform compaction using trench rollers or others to meet the specified compaction requirements. Operate the trench roller as directed until the course is compacted. Hand, manual or mechanical tamping, may be used in such areas if it is proved to the Engineer that the operation will provide the specified density.

### 3.27 SHOULDERS:

- A. Where paved shoulders or curbs are not specified, do not place the shoulder material against the pavement edges until the surface course rolling completed. Take care to prevent distortion of the pavement edge from specified line and grade. When shoulders are paved (except in conjunction with the traveled way paving), cold joint construction procedure is required to assure a tight bond at the joint.
- B. When the rolling of the surface has been completed and the edges have been

thoroughly compacted, immediately place shoulder material against the edges and roll it.

### 3.28 DENSITY AND SURFACE REQUIREMENTS:

- A. The average mat density shall be equal to or greater than 93 percent of the maximum density as determined by ASTM D2041 and no individual sample shall be less than 92 percent of maximum (Rice's) density, prepared as specified in Part 2-Products in this section and made from plant mix meeting the job-mix formula. Verification of maximum density as determined by ASTM D2041 from plant produced material during production is recommended.
- B. Produce a final surface that is uniform in texture and meets the line and grade specified. Before final acceptance of the Project or during the progress of the work, the Engineer will determine the thickness of all courses. Repair or replace all unsatisfactory work.
- C. Assure density and thickness meets the plans and specifications. During compaction, preliminary tests to aid in controlling the thickness, may be performed by inserting a flat blade, correctly graduated, through the material to the top of the previously placed base, or by other approved methods.
- D. In checking compacted depth, the cutting of the test holes, refilling with acceptable materials and proper compaction may be performed by the Owner's testing agency.
- E. For testing the surface on all courses, a 10-foot (3 m) straightedge will be used with the centerline of the straightedge placed parallel to the roadway centerline.
- F. Any variations that exceed 5/16-inch (0.8 cm) in 10 feet (3 m) for base course and 1/4-inch (0.64 cm) in 10 feet (3 m) for surface course must be corrected. Correct irregularities that may develop before the completion of rolling by loosening the surface mix and removing or adding materials as is required. If any irregularities or defects remain after the final compaction, remove the surface course and place and compact new material to a true and even surface. All minor surface projections, joints and minor honeycombed surfaces must be rolled smooth to grade, as directed.
- G. Remove and replace areas of new pavement requiring patching as directed. Patching material will be tested for meeting specifications. The cost of testing is at Contractor expense.

### 3.29 PAVEMENT AND MATERIAL TESTING REQUIREMENTS:

- A. Contractor's independent testing agency will provide core samples of asphalt surface courses to check in place density and compacted depth. The cores are 4-inch (10 cm) diameter. Materials and acceptance tests will be made by the

Contractor's independent testing agency to determine the Contractor's compliance with the specifications. Collect and test one core sample for every 400 feet of paving. Provide a certified laboratory report from the samples taken as to thickness and actual density.

- B. Materials failing to meet the tests specified may be retested if approved and as directed by the Engineer. The Contractor shall pay the costs of any required re-testing for acceptance purposes. Re-testing will be performed by the Owner's testing agency unless otherwise approved by the owner. If there is a dispute, a third party testing firm may be retained by the contractor for additional retesting for the Engineer's review and consideration.
- C. The costs of the following tests are at Contractor expense:
  - 1. Initial aggregate quality tests
  - 2. Job-Mix Formula
  - 3. Any tests the Contractor requires to control his crushing, screening or other construction operations
  - 4. Initial in place density and compacted depth
  - 5. Re-testing of failing tests as provided above
- D. Correct all pavement composition, field density, or thickness, deficiencies at Contractor expense.
- E. The field density and thickness of the pavement is determined by measuring the cores tested. The actual thickness must be no less than 1/4-inch (6.5 mm) from the specified thickness.
- F. When the measurement of any core is less than the plan thickness by more than the allowable deviation, the actual thickness of the pavement in this area may be determined by taking additional cores at intervals of parallel to the centerline in each direction from the affected location. Continue in each direction until a core is found which is not deficient by more than the allowable deviation. The Engineer will evaluate areas found deficient in thickness and determine which areas warrant removal. Remove and replace the areas with asphaltic concrete of the thickness shown on the plans. Additional coring is considered as re-testing of failing areas.

**PART 4: MEASUREMENT AND PAYMENT**

**4.1 ASPHALT CONCRETE PAVEMENT**

- A. Measure asphalt concrete pavement by the square foot in its final position at the depth specified in the bid schedule. Payment for asphalt concrete pavement will be according to the designed quantity as shown in the bid schedule unless it is determined by the Contractor and verified by the Engineer that errors exist in the original design that cause the pay item quantity to change by 10 percent or more. Payment will be full compensation for the work prescribed in this Section.

**END OF SECTION**

## SECTION 02515

### RIPRAP, BOULDERS AND LOGS

#### PART 1 – GENERAL

##### 1.1 SUMMARY

- A. Section includes furnishing and placing riprap for bank and slope protection, and erosion control. This section also includes and placing boulders and logs provided by the owner.

##### 1.2 PREINSTALLATION MEETINGS

- B. Preinstallation Conference: Conduct conference at the Project site.

#### PART 2 – PRODUCTS

##### 2.1 MATERIALS

- A. Conform to the following materials:

1. Furnish riprap materials meeting the following:

	Percent of Rock Equal or Smaller	Range of Rock Mass (pounds) <sup>(3)</sup>	Range or Intermediate Dimension (inches) <sup>(2)</sup>
Class 3	100	750 to 1600	21 – 27
	85	270 to 560	15 – 19
	50	110 to 220	11 – 14
	15 <sup>(1)</sup>	42 to 81	8 - 10
Class 6	100	4850 to 7400	39 - 45
	85	220 to 550	28 - 32
	50	22 to 220	20 - 23
	15 <sup>(1)</sup>	180 to 400	13 - 17

- (1) Furnish spalls and rock fragments graded to provide a stable dense mass.
- (2) The intermediate dimension is the longest straight-line distance across the rock that is perpendicular to the rock's longest axis on the rock face with the largest projection plane.
- (3) Rock mass is based on a specific gravity of 2.65 and 85 percent of the cubic volume as calculated using the intermediate dimension.

B. Boulders

Boulders may be provided by the owner, and will be available on site or from a nearby location.

C. Logs

Logs may be provided by the owner, and are anticipated to have been reclaimed from the river. Logs will be available onsite, or from a nearby location.

## **PART 3 – EXECUTION**

### **3.1 REFERENCES**

- A. Perform the work under Section “Street Excavation Backfill and Compaction.” Dress the slope to produce a smooth surface.

### **3.2 KEYED RIPRAP**

- A. Perform work below the Q2 elevation “in the dry” when the river surface elevation is below the project disturbance elevation.
- B. Keyed riprap is rock placed on a prepared surface and set into place by impact pressure.
- C. Protect existing mature shrubs on the river bank unless the shrub is identified to be removed by the Engineer.
- D. Place riprap to its full thickness in one operation to avoid displacing the underlying material. Do not place riprap material by methods that cause segregation or damage to the prepared surface. Place willow cuttings between the rock while placing the riprap, perform the willow cutting work under the “Landscaping” Section.
1. Rock should be sorted so that largest rock is placed at toe below Q2 elevation (OHW, predominantly 3 ft. diameter and larger)
  2. Place or rearrange individual rocks by mechanical or hand methods to obtain a dense uniform blanket. Bank line at toe of slope should be irregular, with 1-3 foot protrusions to provide velocity breaks at potential high water
  3. Set the riprap into place by exerting impact pressure with a hydraulic-powered bucket or an approximately 5000-pound flat faced mass. Repeat impact should be made until the rock is firmly seated and forms a reasonably uniform surface without reducing the effective sizes of the rocks.
  4. Do not use impact pressure on riprap below the water surface.
- E. Refer to Section 02900, Landscaping, for the planting of willow cuttings within the riprap areas.

### 3.3 BOULDERS

- A. Place boulders on a prepared surface and set into place using slings to prevent marring of the rocks by equipment. Place boulder to provide minimum of exposed rough or fractured edges. Set the boulder to remain stable and in place after placement. Bury the bottom 1/3 of the rock into the ground and compact the soil around the boulder.

### 3.4 LOGS

- A. Place logs on a prepared surface and set into place by hand or with mechanical methods. Set the logs to remain stable and in place after placement. Predrill a 1/2" diameter holes 5' from each end of the log and place a 1/2"x36" rebar thru the log and into the ground. Pound the rebar in so that no part of the rebar is exposed above the log. Bury the bottom 1/4 of the log into the ground and compact the soil around the boulder.

## **PART 4: MEASUREMENT AND PAYMENT**

### A.1 RIPRAP

- A. Measure riprap by the cubic yard in place. The accepted quantities will be paid at the contract price per unit of measurement for the pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this section.

### A.2 BOULDERS

- A. Boulders will not be paid for separately. Payment for boulders placed at the direction of the Engineer will be made on a hourly basis under Equipment Rental. Payment will be full compensation for all work and incidentals required to move and place the boulders.

### A.3 LOGS

- A. Logs will not be paid for separately. Payment for logs placed at the direction of the Engineer will be made on a hourly basis under Equipment Rental. Payment will be full compensation for all work and incidentals required to move and place the logs.

## **END OF SECTION**



## SECTION 02520

### BITUMINOUS SURFACE TREATMENT

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work is the production and placement of bituminous material with cover aggregate on a treated aggregate base. A double application is required.
- B. Furnish all labor, equipment and materials to construct a layer of bituminous surface on a treated base course prepared in accordance with these specifications and to the lines, grades and details shown in the plans or as established by the Engineer.

##### 1.2 REFERENCES

AASHTO T11 (ASTM D1140)	Amount of Material Finer than No. 200 (0.075 mm) Sieve in Aggregate
ASTM D5361	Standard Practice for Sampling Compacted Bituminous Mixtures for Laboratory Testing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89 (ASTM D4318)	Determining Liquid Limit of Soils
AASHTO T90 (ASTM D4318)	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T176 (ASTM D2419)	Sand Equivalent Value of Soils and Fine Aggregate
AASHTO T96 (ASTM C131)	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D3666	Evaluating and Qualifying Agencies Testing and Inspecting
ASTM D5821	Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM C123	Lightweight Particles in Aggregate
ASTMC142	Clay Lumps and Friable Particles in Aggregates

#### PART 2: PRODUCTS

##### 2.1 GENERAL

- A. The specific type and grading of aggregate shall be consistent with those used on other local, state, or federal projects with similar type construction as is outlined for this project. Submit proposed aggregate gradation to the Engineer for

approval. Aggregate types and grades are described in this specification.

- B. The bituminous material shall be High-Float Medium-Setting (HFMS). Ensure that the bituminous material is homogenous after thorough mixing provided separation has not been caused by freezing. Perform the polymer modification step before the emulsification process. Provide emulsified bituminous material meeting the requirements outlined in the HFMS Table below:

**HFMS Requirements Table**

Table	Method	Minimum	Maximum
<b><i>Tests on emulsion:</i></b>			
Viscosity, Saybolt Furol at 122°F	AASHTO T 59	50 s	450 s
Storage stability test*, 24 hour	AASHTO T 59	--	1.0%
Sieve test	AASHTO T 59	--	0.1%
Residue by distillation**	AASHTO T 59	65%	--
Oil distillate by distillation	AASHTO T 59	--	3.0%
<b><i>Tests on residue from distillation:</i></b>			
Penetration at 77°F	AASHTO T 49	100 dmm	200 dmm
Float test, 140°F	AASHTO T 50	1,200 s	--
Elastic recovery, at 77°F	AASHTO T 301	58%	--
*After standing undisturbed for 24 hours, ensure the surface has a smooth, homogenous color. **AASHTO T 59 with modifications to include a 400°F ±9°F maximum temperature to be held for a period of 15 minutes.			

- C. Prepare bituminous surface treatment to conform to the lines, grades, thickness and typical cross sections shown in project documents and plans, and shall be finished and approved by the Engineer before the placement of the next course.

## 2.2 PLANT MIX AGGREGATES

- A. Furnish aggregates from acceptable sources approved by the Engineer.
- B. Furnish test data as outlined in this section on each source to be used for acceptance by the Engineer.
- C. Designation of the sources of supply and the acceptability of the material there from, does not extend to the grading of the material as it may naturally come from the pit or crusher. Adjust the crusher and screens to remove certain portions of the material as may be necessary to furnish gravel that will comply with the specifications in the contract. No additional compensation will be allowed for such adjustment of the equipment or the rejection of waste. It is understood that the Engineer may order procurement of material from any portion of any area designated as a pit site and may reject portions of the deposit as unacceptable.

- D. Aggregate materials shall not contain more than 1.5% by weight of clay lumps, shale, or coal, nor lightweight particles shall exceed 3.5% by weight. No combination of clay, shale, coal, or lightweight particles shall exceed 3.5% by weight. Do not use Scoria (fired clay). Aggregate materials shall conform to the grading stipulated in the contract documents. Use reasonable care in the selection of material in a pit so that uniform product will be produced at all times. No compensation will be allowed for such stripping of the pit as may be required in order that satisfactory material may be secured.
- E. Aggregate used shall consist of gravel, crushed to the specified size, crushed stone, composed of hard durable pebbles or stone fragments, reclaimed asphalt pavement, and finely crushed stone filler, sand or natural clean material, or other fine mineral material. The portion of the material retained on the No. 4 sieve (4.74 mm) will be called coarse aggregate and that passing the No. 4 sieve (4.74 mm) and retained on the #200 sieve (0.075) will be called fine aggregate. The material passing the #200 (0.075 mm) will be called mineral filler.
- F. For all gradings of fine aggregate, including any blended fine aggregate and mineral filler, passing a No. 40 sieve (0.425 mm), shall have a liquid limit not exceeding 25 and a plasticity index of not more than 6.
- G. Produce coarse aggregate retained on the No. 4 sieve (4.74 mm) having a minimum of 50% by weight of particles with at least one mechanically fractured face. The coarse aggregate shall not exceed 40% wear at 500 revolutions.
- H. Preliminary acceptance of aggregates proposed for use may be made at the point of production. Final acceptance will be made only after tests of the aggregates are complete and in place.
- I. Bituminous Surface Treatment Aggregate shall conform to the following:

## **REQUIREMENTS FOR AGGREGATE GRADATION**

### **Bituminous Surface Treatment Aggregate**

<b>Sieve Designation</b>	<b>Percent of Weight Passing Sieves</b>
1 inch	100
¾ inch	100
½ inch	84 - 100
3/8 inch	70 - 98
No. 4 Sieve	44 - 70
No. 10 Sieve	20 - 48
No. 40 Sieve	7 - 25
No. 200 Sieve	3 - 10

## 2.3 BINDER MATERIAL

- A. Contractor shall use Performance Grade (PG) Asphalt Binder material meeting the requirements of AASHTO M 320.
- B. Use asphalt binder supplier recommendations for mixing and compaction temperatures.

## PART 3: EXECUTION

### 3.1 EQUIPMENT

- A. Distributor. Furnish an asphalt distributor meeting the following criteria:
  - 1. Capable of heating asphalt evenly;
  - 2. Adjustable full circulation spray bar to 15-foot width;
  - 3. Positive controls including tachometer, pressure gauge, volume measuring device, or calibrated tank to uniformly deposit asphalt over the full width within 0.02 gallons per square yard of the required rate; and
  - 4. Thermometer for measuring the asphalt temperature in the tank.
- B. Pneumatic-tire rollers. Furnish a minimum of two pneumatic-tire rollers both with the following capabilities:
  - 1. Self-propelled;
  - 2. Minimum compacting width – 5 feet; and
  - 3. Gross weight adjustable within the range of 200 to 360 pounds per inch of compaction width.
- C. Aggregate spreader. Furnish an aggregate spreader meeting the following criteria:
  - 1. Self-propelled;
  - 2. Minimum of 4 pneumatic tires on 2 axles; and
  - 3. Positive controls to uniformly deposit the aggregate over the full width of asphalt within 10 percent by mass of the required rates
- D. Other equipment. Other equipment of proven performance may be used in addition to or in lieu of the specified equipment when approved by the Engineer. Provide two-way communication between the asphalt distributor and the aggregate spreader.

### 3.2 WEATHER LIMITATIONS

- A. Apply bituminous surface treatment only when ambient air and surface temperatures are above 60 °F and rising, when the weather is not foggy or rainy, and when rain is not anticipated for at least 24 hours after application.
- B. Complete all bituminous surface treatment applications at least 2 hours prior to sunset.

### 3.3 PRODUCTION START-UP PROCEDURES

- A. At least 10 days before the start of constructing bituminous surface treatment operation, arrange for a pre-surface treatment conference. Coordinate attendance with the Engineer and any applicable subcontractors. Be prepared to discuss or submit the following:
  - 1. Proposed schedule of operations.
  - 2. List of all equipment and personnel to be used in the production and construction of the work.
  - 3. Discuss spill prevention and safety contingency plan.
- B. Provide at least 7 days advance notice before constructing bituminous surface treatment.
- C. On the first day of placement of the bituminous surface treatment layer, or whenever there is a change in the surface texture or aggregate gradation, construct a 500-foot control strip that is one-lane wide.
- D. Construct the control strip using material, lay-down, and compaction procedures intended for the remainder of the surface treatment. Cease production after construction of the control strip until the material and the control strip are evaluated and accepted by the Engineer.
- E. Acceptable control strips may remain in place and will be accepted as a part of the completed surface treatment.
- F. Repeat the control strip process until an acceptable control strip is produced.

### 3.4 SURFACE PREPARATION

- A. Place treated aggregate base course in accordance with Section 02235. Treated aggregate base course shall be of a 4" compacted thickness as shown in the Drawings.
- B. Prime the treated aggregate base course surface according to Section 02520. Allow the primed surface to cure for 24 hours. Ensure that the primed surface is slightly damp.

### 3.5 SINGLE-COURSE BITUMINOUS SURFACE TREATMENT

- A. A single-course bituminous surface treatment consists of applying High-Float Medium-Setting asphalt treatment material onto the prepared base course surface immediately followed by a single, uniform application of aggregate.
- B. Apply the High-Float Medium-Setting asphalt treatment material according to the following criteria. Determine the exact rates based on approved control strips.
  - 1. Calibrate the asphalt distributor spray bar height, nozzle angle, and pump pressure and check longitudinal and transverse spread rates weekly according to ASTM D 2995. Ensure that the length of the spread is no more than can be covered with aggregate immediately after application.
  - 2. Protect the surfaces of nearby objects to prevent spattering or marring. Spread building paper on the surface for a sufficient distance from the beginning and end of each application so the flow through the distributor nozzles may be started and stopped on the paper.
  - 3. The Engineer will approve the exact application rate, temperature, and area to be treated before application and may make adjustments for variations in field conditions. Apply the asphalt uniformly with an asphalt distributor. Move distributor forward at the proper application speed at the time the spray bar is opened. Use care not to apply excess asphalt at the junction of spreads.
  - 4. Correct skipped areas or deficiencies. Remove and dispose of paper or other material used.
- C. Apply the Bituminous Surface Treatment Aggregate according to the following criteria. Determine the exact rates based on approved control strips.
  - 1. The Engineer will approve the exact application rate and area to be treated before application. Apply the surface aggregates uniformly with an aggregate spreader immediately after the High-Float Medium-Setting asphalt treatment material is applied. Operate aggregate spreader so the asphalt is covered with the aggregate before wheels pass over it. During part-width construction, leave uncovered a strip of sprayed asphalt approximately 6 inches wide to permit an overlap of High-Float Medium-Setting asphalt treatment material.
  - 2. Immediately correct excesses and deficiencies by brooming or by the addition or removal of surface aggregate until a uniform texture is achieved. Use hand methods in areas not accessible to power equipment.
  - 3. Operate rollers at a maximum speed of 5 miles per hour. Do not permit the surface aggregate to be displaced by pickup or sticking of material to

the tire surface. Sufficiently roll the surface to uniformly and thoroughly bond the surface aggregate over the full width. Complete rolling within 1 hour after the High-Float Medium-Setting asphalt treatment is applied to the surface.

- D. During the initial 45 minutes after completion of rolling, limit the traffic speeds to 10 miles per hour. Limit traffic speeds to 20 miles per hour for 24 hours.
- E. Lightly broom the aggregate surface on the morning after construction. Maintain the surface for 4 days by repairing areas deficient in aggregate. Sweep excess material from the surface using a rotary power broom when the temperature is less than 75 °F. Do not displace embedded material.

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 BITUMINOUS SURFACE TREATMENT**

- A. Bituminous surface treatment will be measured and paid for by the square yard, in place. Payment will be full compensation for the work prescribed in this Section.

**END OF SECTION**

## **SECTION 02528**

### **CONCRETE CURB**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This work is constructing combined curb and gutter and ribbon curb using structural concrete and meeting the lines, dimensions, and grades shown on the plans and these specifications.

##### **1.2 REFERENCES**

- |              |  |
|--------------|--|
| AASHTO M 213 | Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction |
| AASHTO M148  | Standard Specification for Liquid-Forming Compounds for Curing Concrete                                      |

#### **PART 2: PRODUCTS**

##### **2.1 STRUCTURAL CONCRETE**

- A. Furnish structural concrete meeting the requirements of Section 03310, STRUCTURAL CONCRETE.

##### **2.2 PRE-FORMED EXPANSION JOINT MATERIAL**

- A. Furnish joint material meeting the requirements of AASHTO M213.

##### **2.3 GRAVEL BASE MATERIAL**

- A. Furnish gravel base meeting all applicable portions of Section 02235, CRUSHED BASE COURSE, and meeting gradation requirements for 3/4" minus material.

##### **2.4 CURING AND PROTECTIVE COATING MATERIALS**

- A. Liquid Membrane-Forming Compounds for Curing Concrete
  - 1. Furnish liquid membrane-forming compound meeting the requirements of AASHTO M148, Type 1, clear or translucent.
- B. Emulsified Linseed Oil Compound
  - 1. Assure it meets all requirements of AASHTO M148 and contains at least



2.7 pounds (0.32 kg) of linseed oil per gallon (liter). Furnish a manufacturer's certification showing that the formulated weight of linseed oil per gallon equals or exceeds this limit.

### **PART 3: EXECUTION**

#### **3.1 GENERAL**

- A. Concrete curb and gutter may be machine-laid or hand-formed. Perform work meeting these requirements and the applicable requirements of Section 03310, STRUCTURAL CONCRETE.

#### **3.2 FOUNDATION PREPARATION**

- A. Excavate the foundation to the specified depth. Assure the subgrade or base course for the concrete has a firm and even surface and is compacted meeting Section 02230, STREET EXCAVATION, BACKFILL, AND COMPACTION.
- B. Complete excavation to the lines shown in the contract documents.
- C. Place at least 4 inches of crushed base course material and compact it to a firm, even surface under all curb and gutter. This requirement is waived if curb and gutter is installed on a portion of street base course material of 4 inches or more in thickness.
- D. For new street construction or street reconstructing place gravel base course for the street to the back of the curb.

#### **3.3 FORMS**

- A. Use metal forms unless otherwise approved of the depth equal to the face of the item being constructed. Obtain Engineer approval of in-place forms before placing concrete.
- B. Assure forms produce the shape, lines, and dimensions shown on the plans and/or drawings. Assure forms prevent leakage of mortar and maintain position and alignment. Thoroughly clean and oil before placing and do not remove forms until the concrete has hardened sufficiently to prevent damage.
- C. Where the curb and gutter is to abut an existing sidewalk, use an approved face-of-gutter form secured to maintain an established gutter grade. Vary the curb height to assure the top of curb matches as nearly as possible the standard curb and gutter cross section. Obtain Engineer approval to hand form lengths not exceeding 10 feet (3m).
- D. Form radii using flexible or curved metal forms set to fit the specified curvature.

Obtain Engineer approval before using wood forms. Radii may be formed by using segments of straight forms if the length of the straight segment does not exceed one-tenth of the length of the radius.

### 3.4 REINFORCEMENT

- A. Place reinforcement as required. Place and hold in position before placing concrete.

### 3.5 PLACING CONCRETE

- A. Place and compact the gravel base material to the specified grade before placing concrete. Dampen the gravel base material just before placing the concrete. Spade and tamp the concrete thoroughly into the forms to provide a dense, compacted concrete free of rock pockets. Float, finish, and broom the exposed surfaces. Each placing/finishing crew shall have at least one ACI Flatwork Finishing Technician, or approved equivalent, on site at all times.
- B. Do not place concrete at a rate that exceeds the finishing operation's ability to meet these specifications.
- C. Machines or equipment that extrude curb and gutter may be used when approved, provided they produce a finished product matching that obtained by the set-form method. Use slip-form machines that are automatically controlled for longitudinal grade, alignment, and transverse slope by sensing devices operating from string lines set from construction stakes placed by the Engineer.

### 3.6 STRIPPING FORMS AND FINISHING

- A. Forms
  - 1. Remove forms when the concrete is sufficiently set to prevent chipping or spalling. When forms are removed before the curing period has expired, protect the concrete edges with moist earth or spray edges with curing compound. Clean, oil, and examine all forms for defects before they are used again.
- B. Finishing
  - 1. Finish the surface of concrete curbs and gutters true to the lines and grades shown on the plans.
  - 2. Fill honeycomb or other blemishes in formed surfaces with grout to the specified finish. Tool all edges to a ¼-inch (6.4 mm) radius. Float the surface using a magnesium float to a smooth and uniform surface. When the concrete in the curb and gutter has hardened sufficiently, give the surface a broom finish. Obtain Engineer approval of the broom before

use. Broom the surface without tearing the concrete. Broom to produce regular corrugations not exceeding 1/8-inch (3.2 mm) deep.

C. Crew

1. Do not apply additional surface water. The Engineer may permit adding water, but it must be applied by fog spray only. Use of an evaporation retardant, Confilm, or equal, following the manufacturer's directions is permitted.

### 3.7 CURING

- A. Curing meeting Section 03310, STRUCTURAL CONCRETE, requirements.

### 3.8 JOINTS

- A. Place curb and gutter monolithically with no construction joints permitted, except at planned expansion joints.
- B. Construction expansion joints at radius points, construction joints, junctions with existing concrete, opposite to or at expansion joints in adjacent concrete, and at maximum 330-foot (92 m) intervals, in a continuous run of concrete being placed. Form expansion joints using 1/2-inch (12.7 mm) thick, pre-formed expansion joint filler, as specified in Section 02528.2.2.
- C. Form or cut contraction joints 1/8-inch (3.2 mm) wide to one-fourth the depth of the concrete being placed. Construct the joints to coincide with the joints in adjacent concrete or in uniform sections 10 feet (3 m) in length. Where required to make a closure, sections less than 10 feet (3 m) in length will be permitted with the minimum length being 4 feet (1.2 m). When contraction joints are made by approved forming or grooving before the concrete has set, tool the edges to the approved radius.

### 3.9 CURB BACKFILL

- A. Complete the curb backfill to 4 inches (10 cm) below the top of curb before final grading of the subgrade and placing the base course.
- B. Backfill using topsoil up to 4 inches (10 cm) below top of curb. Do not use sand or gravel backfill in this area.
- C. In areas of existing lawns or constructed boulevards, use black loam or approved topsoil for the top 4 inches (10 cm) of backfill. Place it out from the curb and in the amount required to replace the turf or lawn removed during installation. Place the backfill to a point level with the top of the curb, immediately adjacent to the curb, and grade and blend to match the existing undisturbed lawn area.

- D. Where lawns do not exist, place the top 4 inches (10 cm) of backfill using impervious dirt and conforming to the typical sections shown on the plans.
- E. Compact backfill to prevent settlement and level the surface to be free draining.

### 3.10 PRIME AND SEAL COAT PREPARATION

- A. Paint the edge of the gutter adjacent to the asphalt surfacing with an asphalt prime coat before placing the pavement surface course. When an asphalt seal coat is specified, apply the oil and cover aggregate 3 inches (7.6 cm) on to the gutter to provide a good seal on the joint between the concrete and pavement.

### 3.11 TOLERANCES

- A. Perform the work to produce a curb and gutter meeting the specified line and grade uniform in appearance and structurally sound. Remove and replace at contractor expense curb and gutter having unsightly bulges, ridges, and/or low spots in the gutter, or other defects as directed. Grade cannot deviate more than 1/8-inch (3.2 mm), and alignment not vary more than 1/4-inch (6.4 cm) from plan elevation, grade or alignment. Tolerances may be checked using survey instruments, straight edges, or water puddling. Puddled water cannot exceed 1/4-inch (6.4 mm) in depth.

## **PART 4: MEASUREMENT AND PAYMENT**

### 4.1 COMBINED CONCRETE CURB AND GUTTER

- A. This item is measured and paid for by the lineal feet of combined curb and gutter in place at the contract unit price bid. Price and payment is full compensation for all materials, furnishing and placing crushed base course, curing of concrete, painting face gutter with primer, all pre-molded mastic material for expansion joints, contraction joints, steel dowels and sleeves, all equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item. The lineal feet (meter) measurement is the horizontal distance measured along the face of the curb.

### 4.2 COMBINED CONCRETE RIBBON CURB

- A. This item is measured and paid for by the lineal feet of ribbon curb in place at the contract unit price bid. Price and payment is full compensation for all materials, furnishing and placing crushed base course, curing of concrete, painting face gutter with primer, all pre-molded mastic material for expansion joints, contraction joints, steel dowels and sleeves, all equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item. The lineal feet (meter) measurement is the horizontal distance measured along the front edge of the curb.

**END OF SECTION**

## **SECTION 02529**

### **CONCRETE SIDEWALKS AND MISCELLANEOUS NEW CONCRETE CONSTRUCTION**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This work is the construction of concrete sidewalk and all other miscellaneous new concrete construction complete in place.

##### **1.2 REFERENCES**

AASHTO M213	Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO M148	Standard Specification for Liquid-Forming Compounds for Curing Concrete

#### **PART 2: PRODUCTS**

##### **2.1 STRUCTURAL CONCRETE**

- A. Furnish structural concrete meeting the requirements of Section 03310, STRUCTURAL CONCRETE.

##### **2.2 PRE-FORMED EXPANSION JOINT MATERIAL**

- A. Furnish joint material meeting the requirements of AASHTO M213.

##### **2.3 GRAVEL BASE MATERIAL**

- A. Furnish gravel base meeting all applicable portions of Section 02235, CRUSHED BASE COURSE, and meeting gradation requirements for 3/4" minus material.

##### **2.4 CURING AND PROTECTIVE COATING MATERIALS**

- A. Liquid Membrane-Forming Compounds for Curing Concrete
  - 1. Use liquid membrane-forming compounds meeting the requirements of AASHTO M148, Type 1, clear or translucent. Apply the compound between April 15 and August 14.
- B. Emulsified Linseed Oil Compound
  - 1. Apply water-soluble or emulsified linseed oil compound between August

15 and April 14 as a protective coat. Assure it meets all requirements of AASHTO M148 and contains at least 2.7 pounds of linseed oil per gallon. Furnish a manufacturer's certification showing that the formulated weight of linseed oil per gallon equals or exceeds this limit.

## 2.5 CONDUIT SLEEVES

- A. Furnish and supply 2-inch diameter conduits to be placed under the trail at locations specified by the Engineer. Conduit material other than Sch. 40 PVC must first be approved by the Engineer.

## 2.6 STAINED CONCRETE

- A. Furnish stained structural concrete meeting the requirements of Section 03310, STRUCTURAL CONCRETE. Color of concrete stain shall be rust brown. Submit color sample of stained concrete to the Engineer for approval prior to ordering stained concrete.

# PART 3: EXECUTION

## 3.1 GENERAL

- A. Construct sidewalks at the locations shown on the plans and where directed by the Engineer meeting these specifications and the applicable portions of Section 03310, STRUCTURAL CONCRETE.
- B. The use of slip form machines is prohibited for items in this section unless otherwise specified or permitted by the Engineer.

## 3.2 FOUNDATION PREPARATION

- A. Excavate to the specified depth. Assure the subgrade where the concrete to be placed has a firm and even surface and is compacted as specified in Section 02230, STREET EXCAVATION, BACKFILL AND COMPACTION.
- B. Place and compact crushed base course material, to the compacted depths shown in the Drawings, to a firm, even surface.
- C. Place conduit sleeves below the gravel base material at locations specified by the Engineer.

## 3.3 FORMS

- A. Furnish forms to produce the shape, lines, and dimensions shown on the plans and/or drawings. Assure forms prevent leakage of mortar and are maintained in

proper position and accurate alignment. Thoroughly clean and oil forms with an approved form oil before placing concrete and remove forms only after the concrete has hardened sufficiently to support all loads without damage.

- B. Form radii using flexible or curved metal forms set to the required curvature. Use wood forms only with the Engineer's approval. Radii may be formed by using segments of straight forms if the length of the straight segment does not exceed one-tenth of the length of the radius.
- C. Use 6-inch (15 cm) forms and 6-inch (15 cm) pre-formed expansion joint material for concrete 6 inches (15 cm) in depth.

### 3.4 REINFORCEMENT

- A. Place and hold in position reinforcement meeting the contract requirements before placing the concrete.

### 3.5 PLACING CONCRETE

- A. Assure the base is compacted and brought to specified grade before placing concrete. Dampen the subgrade immediately before placing the concrete. Spade and tamp the concrete into the forms providing a dense, compacted concrete free of rock pockets. Float, finish and broom the exposed surfaces. Each placing/finishing crew shall have at least one ACI Flatwork Finisher Technician, or approved equivalent, on site at all times.
- B. Assure the rate of concrete placement does not exceed the rate at which the various placing and finishing operations can be performed in accordance with these specifications.

### 3.6 STRIPPING FORMS AND FINISHING

- A. Forms
  - 1. Remove forms when the concrete is sufficiently set to prevent chipping or spalling. When forms are removed before the curing period has expired, protect the concrete edges with moist earth or spray edges with curing compound. Clean, oil, and examine all forms for defects before they are used again.
- B. Finishing
  - 1. Finish the concrete surface true to the lines and grades shown on the plans. Float the concrete surface using a magnesium float to a smooth and uniform surface. Plastering of the surface is prohibited. Edge all outside edges of the slab and all joints using a 1/4-inch (6.5 mm) radius-edging



tool. After concrete has hardened sufficiently, give the surface a broom finish. Assure the broom strokes are square across the concrete from edge to edge, overlapping adjacent strokes. Broom without tearing the concrete. Assure the broomed finish produces regular corrugations not exceed 1/8-inch (3mm) in depth.

2. Place stamps or markings at locations where conduit under the sidewalk has been installed. Submit proposed stamping styles and techniques to the Engineer for approval before implementation.
3. Install truncated dome panels at locations as shown on the drawings. Place panels in wet concrete according to manufacturer guidelines and printed instructions.

C. Stamping

1. Stamp concrete ensuring that the template used is matched along all edges. Apply force to stamping template to obtain proper stamp indentation. Apply liquid sealer and accent agent to finished surface of stamped concrete at rate recommended by manufacturer.

### 3.7 CURING

- A. Cure meeting Section 03310, STRUCTURAL CONCRETE requirements.

### 3.8 JOINTS

- A. Extend isolation joints the full depth of the concrete and fill using 1/2-inch (12 mm) thick, pre-formed joint filler as specified in Section 02529.3.3. Place isolation joints meeting this requirement where new concrete abuts existing concrete. Form isolation joints around all appurtenances, such as manholes, utility poles, etc. extending into and through the concrete.
- B. Install pre-formed joint filler between concrete and any fixed structure, such as a building or bridge. Assure all expansion joint materials extend the full depth of the concrete. Place isolation joints at radius points, junctions with existing concrete, and opposite to or at expansion joints in adjacent concrete. Form cold joints at unions of consecutive pours as shown on the plans or directed by the Engineer. Assure the cold joint is vertical, the full depth of the concrete, and tooled to a 1/4-inch (6.5 mm) radius.
- C. Divide sidewalk into sections using contraction joints formed by a jointing tool or other approved methods. Extend the contraction joints into the concrete for at least one-fourth of its depth and be approximately 1/8-inch (3 mm) wide. Unless otherwise directed, space contraction joints at maximum 10-foot (3 m) intervals or at a distance equal to the sidewalk width, whichever is less. In continuous

sidewalk runs, install isolation joints at the location of a regular contraction joint if the distance between isolation joints does not exceed 300 feet.

### 3.9 BACKFILL

- A. In areas adjacent to existing lawns, backfill the top 4 inches using black loam or good topsoil suitable for lawn growth. Place it out from the sidewalk or driveway to replace turf or lawn removed during installation. Place the backfill level with the top of the curb, immediately adjacent to the curb, graded and blended to match the existing undisturbed lawn area.
- B. Where lawns do not exist, backfill the top 4 inches with impervious dirt and place to meet the typical sections shown on the plans.
- C. Compact backfill to prevent settlement and level the surface to a neat appearing and free draining surface.

### 3.10 TOLERANCES

- A. Assure all items of construction covered by this section present clean, uniform surfaces and lines free of irregularities and distortions. Plane surfaces and vertical tangent lines are tested with a 10-foot straightedge and cannot deviate more than 1/4-inch (6.5 mm) from the straightedge.

### 3.11 MISCELLANEOUS NEW CONCRETE CONSTRUCTION

- A. Construct new street monuments, new street light bases, and other miscellaneous concrete construction in accordance with detail drawings.

## **PART 4: MEASUREMENT AND PAYMENT**

### 4.1 CONCRETE SIDEWALK

- A. Measure concrete sidewalk by the square foot in its final position at the depth specified in the bid schedule. Payment for concrete sidewalk will be according to the actual quantity constructed at the contract unit price shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section.

### 4.2 STAINED, STAMPED, OR BRUSHED CONCRETE

- A. Stained, stamped, and brushed concrete finish is not measured for payment but is incidental to other items in the contract.

### 4.3 CONDUIT

- A. This item is measured and paid for by the number of conduits constructed as shown in the drawings and as directed by the Engineer at the contract unit price for the item listed below. Price and payment is full compensation for all materials, excavation, backfill, stamping of concrete, equipment, tools and labor, and for the performance of all work and incidentals necessary to complete this form.

#### 4.2 MISCELLANEOUS CONCRETE

- A. Unless addressed otherwise in the contract documents, Miscellaneous Concrete items will not be measured for payment but will be considered incidental to other items in the contract.

**END OF SECTION**

## SECTION 02581

### PAVEMENT MARKINGS AND MARKERS

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work includes applying epoxy paint lines, symbols, and other markers meeting these specifications, the Drawings, and in reasonably close conformity with the lines and dimensions shown in the contract documents or established by the Engineer.

##### 1.2 SUBMITTALS

- A. Submit manufacturer's literature for epoxy paint material to the Engineer. Mark literature to show the exact type of epoxy paint to be used for the project.

#### PART 2: PRODUCT

##### 2.1 EPOXY PAINTED PAVEMENT MARKING MATERIAL

- A. Furnish a 2-component, 100 percent solids type system for hot-spray application conforming to the following:

- 1. Pigments. Component A. Percent by mass.
  - a. White
    - i. Titanium dioxide (TiO<sub>2</sub>),  
ASTM D 476, type II and type III 18% min.
    - ii. Epoxy resin 75 to 82%
  - b. Yellow:
    - i. Chrome yellow (PbCrO<sub>4</sub>),  
ASTM D 126, type III. 23% min.
    - ii. Epoxy resin 70 to 77%
  - c. Non-Lead Yellow:
    - i. Titanium dioxide (TiO<sub>2</sub>)  
ASTM D 476, type II and type III. 14% min.
    - ii. Organic yellow 7 to 8%
    - iii. Epoxy resin 75 to 79%
- 2. Epoxy content. Component A. Manufacturer's target value  $\pm 50$   
Mass per epoxy equivalent, ASTM D 1652

- |     |   |   |
|-----|---|---|
| 3.  | Amine value. Component B,<br>ASTM D 2074  | Manufacturer's target<br>value $\pm 50$           |
| 4.  | Toxicity. Toxic or injurious fumes<br>at application temperature  | none  |
| 5.  | Color. 15 mil film thickness specimen(cured).<br><br>a. White, ASTM D 1729: Match FHWA standard highway white<br>b. Yellow, ASTM D 1729: Match FHWA standard highway yellow |   |
| 6.  | Directional reflectance. (Without glass beads)<br><br>a. White, ASTM E 1347<br><br>b. Yellow, ASTM E 1347   |   |
|     |   | 84% relative to<br>magnesium oxide                |
|     |   | 55% relative to<br>magnesium oxide                |
| 7.  | Drying time. 15 mil film thickness with beads.<br><br>a. Laboratory at 72 °F, ASTM D 711<br><br>b. Field at 77 °F, viewed from 50 feet                                      |   |
|     |   | 30 minutes maximum<br>to no-pick-up<br>condition  |
|     |   | 10 minutes maximum<br>to no-tracking<br>condition |
| 8.  | Abrasion resistance. Wear index<br>with a CS-17 wheel under a 35.3 ounce load<br>for 1000 cycles, ASTM D 4060   | 82 max.   |
| 9.  | Hardness. Shore D hardness with 72-<br>to 96-hour cure at 72 °F, ASTM D 2240  | 75 to 100   |
| 10. | Storage. When stored for up to 12 months, individual epoxy components<br>shall not require mixing before use.   |   |

### **PART 3: EXECUTION**

#### **3.1 GENERAL**

- A. Upon completion of the final asphalt surface course, establish line limits for the new pavement markings for approval before painting. Establish markings

according to the Drawings.

- B. Remove loose particles, dirt, tar, grease, and other deleterious material from the surface to be marked. Clean the pavement of all residue and curing compounds. Apply markings to a clean, dry surface.
- C. At least 10 days before applying pavement markings, furnish a written copy of the marking manufacturer's recommendations for use. A field demonstration may be required to verify the adequacy of recommendations.
- D. Ship marking material in appropriate containers plainly marked with the following information, as appropriate, for the material being furnished:
  - 1. Manufacturer's name and address;
  - 2. Name of product;
  - 3. Lot/batch numbers;
  - 4. Color;
  - 5. Net mass and volume of contents;
  - 6. Date of manufacture;
  - 7. Date of expiration;
  - 8. Statement of contents (if mixing of components is required);
  - 9. Mixing proportions and instructions; and
  - 10. Safety information.
- E. Apply pavement markings in the direction of traffic according to the manufacturer's recommendations. Apply all markings to provide a clean-cut, uniform, and workmanlike appearance by day and night.
- F. Make lines of sizes as shown in the Drawings.
- G. Protect marked areas from traffic until the markings are dried to no-tracking condition.
- H. Remove all tracking marks, spilled marking material, markings in unauthorized areas, and defective markings.

### 3.2 APPLICATION OF EPOXY PAVEMENT MARKINGS

- A. Heat epoxy pavement marking components separately at  $110 \pm 30$  °F and mix. Discard all material heated over 140 °F.
- B. Apply epoxy when the pavement and air temperatures are above 50 °F. Apply as a spray at  $110 \pm 30$  °F (gun tip temperature) at a 15 mil minimum dry film thickness or 107 square feet per gallon.

## **PART 4: MEASUREMENT AND PAYMENT**

### **4.1 GENERAL**

- A. Paint will not be measured separately for payment. Payment is full compensation for all work necessary to complete the item. Painted traffic lines, symbols, and other markers will be paid for as a lump sum under: Permanent Pavement Markings, Epoxy.
- B. Unless otherwise provided in the contract, removal of pavement markings is incidental to other items in this contract.

**END OF SECTION**

## SECTION 02725

### DRAINAGE CULVERTS

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. Furnish and install all drainage culverts and other appurtenant structures as specified in the Contract and this section. Pipe strength classifications are specified on the Drawings and are listed herein.

##### 1.2 CERTIFICATION BY MANUFACTURER

- A. Furnish a manufacturer's certification on all pipe, certifying that the pipe and fittings meet the contract requirements.

##### 1.3 REFERENCES

AASHTO M36	Corrugated Galvanized Steel Pipe and Pipe Arches
AASHTO M218	Galvanized Steel Coil
AASHTO M245	Pre-Coated Galvanized, Corrugated Steel Pipe and Pipe Arches
AASHTO M274	Type II Aluminized Corrugated Steel Pipe and Pipe Arches
AASHTO M294	Corrugated Polyethylene Pipe (HDPE)
ASTM D361	Low Head Pressure RCP
ASTM C76	Reinforced Concrete Pipe
ASTM C443	O-ring Rubber Gaskets
ASTM C506	RCP – Arch Pipe
ASTM C507	RCP – Elliptical Pipe
ASTM C655	RCP – Tongue & Groove Pipe
ASTM C665	RCP – D-Load Pipe
ASTM A761	Corrugated Steel Structural Plate
ASTM C789	Precast Reinforced Concrete Box Sections
ASTM C850	Precast Reinforced Concrete Box Sections

#### PART 2: PRODUCTS

##### 2.1 GENERAL

- A. Furnish all culvert piping as specified in the Drawings and meeting the materials and testing requirements of this Section. Furnish the pipe sizes and strength classifications show in the Contract documents.



- B. References to ASTM, ANSI or AASHTO designation, means the latest revision at the time of call for bids.
- C. Assure all pipe is clearly marked with type, class and/or thickness as applicable. Assure lettering is legible and permanent under normal handling and storage conditions.
- D. Furnish the joint type, class, thickness designation, casting, lining, marking, testing, etc. as specified.

## 2.2 SUBMITTALS

- A. Submit specifications and shop drawings of trash racks to the Engineer for approval before fabrication and installation.

## 2.3 PIPE MATERIALS

### A. Corrugated Metal Pipe

1. Furnish corrugated metal pipe meeting ASTM A 760(AASHTO M36). Connections must be made with minimum coupling band width of 10-1/2". When specified by the Engineer, materials shall meet the following standards:

ASTM A760 (AASHTO M36)	Specifications for Corrugated Steel Pipe, Metallic-coated for Sewers and Drains
ASTM A762 (AASHTO M245)	Specifications for Corrugated steel Pipe, Polymer Pre-coated for Sewers and Drains
ASTM A742 (AASHTO M246)	Specifications for Steel Sheet, Metallic Coated and Polymer Pre-coated for Corrugated Steel Pipe
ASTM A929 (AASHTO M274)	Specifications for Steel Sheet Metallic Coated by the Hot Dip Process for Corrugated Steel Pipe (Aluminized Type II)

## **PART 3: EXECUTION**

### **3.1 PIPE INSTALLATION**

#### **A. Excavation and Backfill**

1. Excavate and backfill culverts in accordance with manufacturer's specifications and as shown in the Drawings.
2. Bedding material and backfill around and over culverts shall be compacted to 95% of maximum laboratory dry-density, ASTM D690 for all culverts installed in roadway embankments, unless specified otherwise by Engineer.

#### **B. Responsibility for Materials**

1. The Contractor shall be responsible for all material furnished. Replace all material found defective in manufacture or damaged in handling after delivery by the manufacturer. This includes furnishing all material and labor required for the replacement of installed material discovered defective before final acceptance of the work or during the guarantee period.
2. The Contractor shall be responsible for the safe storage of material for the work until it has been incorporated in the completed project.

#### **C. Handling of Pipe**

1. Load and unload pipe, fittings and accessories by lifting with hoists or skidding so as to avoid shock or damage. Do not drop the materials. Do not skid or roll pipe handled on skidways against pipe already on the ground.
2. In distributing the material at the work site, unload each piece opposite or near the place where it is to be laid in the trench. Keep the pipe interior and other accessories free from dirt and foreign matter at all times.
3. Handle pipe to prevent coating or lining damage. Repair or replace all coating or lining damage in a manner satisfactory to the Engineer.

#### **D. Laying Pipe.**

1. Lay and maintain all pipe to the specified liens and grades with fittings, at the specified locations.
2. Use tools and equipment meeting Engineer approval for the safe and

convenient prosecution of the work. Carefully lower all pipe and fittings into the trench preventing damage to pipe materials and protective coatings and linings. Do not dump or drop materials into the trench.

3. Exercise care to prevent foreign material from entering the pipe as it is installed. When pipe laying is not in progress, close the open ends of pipe using a plug or other means approved by the Engineer. Remove and clean all sand, gravel, concrete and cement grout that has entered the lines during construction.

E. Tolerances

1. Install pipe within ½ inch (13 mm) of the specified alignment and within 1/4-inch (6 mm) of the specified grade for pipe 15-inch (38 cm) in diameter and smaller and 1/3-inch (13 mm) of specified grade for pipe larger than 15-inch (38 cm) diameter. These tolerances apply to any point along the entire pipe length.

### 3.2 INLETS AND CATCH BASINS

- A. Construct inlets and catch basins meeting the standard drawing for the type specified.
- B. Construct inlet structures to the line, cross-section and dimensions specified. Furnish concrete and reinforcing steel meeting Section 03310: STRUCTURAL CONCRETE and Section 03210: REINFORCING STEEL. Inlet structures may be precast or cast-in-place.

### 3.3 TESTS

A. Visual Inspection

1. Inspect culverts for line, grade and roundness. Repair or replace culverts that are out of round, excessively deflected, or not installed to line and grade requirements.

A. Joints

1. All joints shall be silt tight joints to prevent infiltration and exfiltration of soil and water.

**PART 4: MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. Measure pipe culvert by the linear foot in its final position. Payment for pipe culvert will be according to the actual quantity constructed at the contract unit price shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section.

**END OF SECTION**

## **SECTION 02900**

### **LANDSCAPING**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This section includes all labor, equipment, and materials for planting of willow cuttings as shown on the plans. It includes harvesting the willow cuttings, performing planting operations, and maintenance of the plantings for the warranty period.

#### **PART 2: PRODUCTS**

##### **2.1 WILLOW CUTTINGS**

- A. Harvest willow cuttings from existing willow that are within the project area. Harvest cuttings within 24 hours of the time of installation to prevent desiccation. Existing willows on the Clark Fork River Bank at the downstream terminus of the bank project shall not be removed or disturbed.
  - 1. Follow ethical harvest guidelines to conserve the health of the donor stand:
    - i. Remove no more than 1/3<sup>rd</sup> of the branches on any single willow;
    - ii. Never remove more than 40% of the overall willow canopy cover; and
    - iii. Harvest stems evenly throughout the willow stand.
  - 2. Use lopping shears, hand pruning shears, small wood saws or brush cutters to cut the willows.
  - 3. Select willow stems that are 1/2 to 2 inches in diameter. Cut stems to an approximate length of 5½ feet. Remove the cuttings with a clean diagonal cut near its base, as low as you can remove it from the plant stem and still harvest a healthy cutting. The diagonal cut is used to differentiate the rooting-end from the above ground end, and to aid installation. The top should be prepared with a horizontal cut. Remove all lateral (side) branches along the stem as close to the stem as possible. Use caution to avoid damaging the stem while clipping the lateral branches.
  - 4. Bundle the willow cuttings and store them in a cool, moist, and shaded area onsite.

##### **2.3 TOPSOIL**

- A. Refer to Specification Section 02910, Seeding, for topsoil requirements.

## 2.4 HYDROSEEDING & FERTILIZER

- A. Refer to Specification Section 02910, Seeding, for hydroseeding and fertilizer requirements.

## **PART 3: EXECUTION**

### 1.1 GENERAL

- A. Provide one person to act as supervisor at all times during execution of this portion of the work. This person shall be thoroughly familiar with the types of materials being installed and best methods for their installation, and shall direct all work performed under this section.
- B. Plant material for this project is subject to inspection before, during, and after planting.

### 1.2 PLANTING

- A. The Contractor is responsible for all maintenance and watering of plants until plants are fully established.
- B. When placing the willow cuttings in riprap, place the top end 4-6 inches out of the riprap. Place the cuttings at a density of 3 cuttings per LF. Tops that are cracked or heavily damaged shall be cleanly cut. At least 2 lateral stem buds should be present on the above ground portion of the stem. Be sure that the pointy tips on the lateral buds point sky-ward. Ensure the stem of the cutting is completely surrounded by compacted soil and all air-pockets have been eliminated.

### 1.3 PLANT CARE

- A. Acceptance of Work.
  - 1. The Contractor is responsible for care of all plant materials through final acceptance of the work, starting with delivery of plant materials and continuing until written final acceptance from the Engineer. This includes watering, cultivating, spraying, and pruning to keep the planted areas neat and attractive over the 2-year warranty period.
  - 2. If plant stress is present, adjust and control watering frequency and coverage as required to alleviate stress.

3. Provide a warranty period of 2 years after initial written acceptance for all plant materials.
4. Final acceptance of the work shall be scheduled in no case, less than 2 years after the initial written acceptance of work.

C. Replacements.

1. At the final inspection, all plant material shall be in a healthy growing condition.
2. Should the appearance of any plant indicate weakness and probability of dying, immediately replace the plant with a new and healthy plant of the same type and size without additional cost to the Owner prior to the final acceptance period.
3. When Final Inspection is made and deficiencies noted, care and replacement will continue, until such deficiencies are corrected, at no cost to the Owner.

**PART 4: MEASUREMENT AND PAYMENT**

4.1 LANDSCAPING

- A. Measure willow cuttings by the linear foot planted in place. Payment for willow cuttings will be according to the actual quantity planted and accepted at the contract unit price shown in the bid schedule. Payment will be full compensation for the work described in this section.

**END OF SECTION**

## **SECTION 02910**

### **SEEDING**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This section includes ground surface preparation; furnishing and placing topsoil; furnishing and applying fertilizer; and furnishing and applying hydroseed in areas described in the contract documents or directed by the Engineer.

##### **1.2 SUBMITTALS**

- A. Submit to the Engineer applicable hydroseed mixture certifications, fertilizer descriptions and certifications. Furnish duplicate signed copies of the vendors statements certifying that the hydroseed has been tested by a recognized seed testing laboratory within 6 months of date of delivery. Assure the statement includes:
  - 1. Name and address of laboratory, date of test, and the test results including name, percentages of purity and of germination.
  - 2. Proportions of each kind of seed within the hydroseed mix.
  - 3. Type of binders/tackifiers within the hydroseed mix.
  - 4. Type of fertilizers within the hydroseed mix.

#### **PART 2: PRODUCTS**

##### **2.1 SEED**

- A. Furnish hydroseed seed mixture, free of all prohibited noxious weed seed or any other weed seed prohibited by state or local ordinance.
- B. Seal and label all seed containers to comply with Montana Seed Law and Regulations or meeting U.S. Department of Agriculture and Regulations under the Federal Seed Act, if shipped in interstate commerce.
- C. Furnish a hydroseed comprised of the following seed mixture:
  - 1. Dryland Turf Seed to be placed in construction limits shown on plans:
    - 35% Hard Fescue
    - 30% Sheep Fescue



20% Fairway Crested Wheatgrass  
10% Sodar Streambank Wheatgrass  
5% Canada Bluegrass

*\*Seed at 1-2 pounds per 1,000 Sq. Ft.*

- E. Furnish seed in standard containers labeled with the seed name, lot number, net weight, percentages of purity, germination, hard seed, and percentage of maximum weed seed content for each seed species.

## 2.2 MULCH

- A. Mulch shall be composed of cellulose or wood fiber products with no growth or germination inhibiting substances, and shall be manufactured in such a manner that when thoroughly mixed with seed, fertilizer, organic stabilizer, and water, in the proportions specified, will form homogeneous slurry which is capable of being sprayed to form a porous mat. The fibrous mulch in its air-dry state shall contain no more than 15% by weight of water. The fiber shall have a temporary green dye and shall be accompanied by a certificate of compliance stating that the fiber conforms to these specifications.

## 2.3 ORGANIC STABILIZER/TACKIFIER

- A. Shall be an organic substance supplied in powder form and shall be psilium-based and packed in clearly marked bags stating the contents of each package.

## 2.4 EQUIPMENT

- A. Equipment used for application of slurry shall be a commercial-type Hydro-Seeder and have a built-in agitation system with an operation capacity sufficient to agitate, suspend and homogeneously mix slurry. Tank capacity shall be a minimum of 1,500 gallons and shall be mounted on a truck to allow access to the site. Distribution lines shall be large enough to prevent stoppage and allow for even distribution of slurry over the site. Pump shall be able to generate 150 psi at the nozzle.

## 2.4 FERTILIZER

- A. Fertilizer shall be a starter derived from *urea formaldehyde* (N-P-K 6-24-24) and comply with U.S. Department of Agriculture and Regulations

## 2.5 WATER

- A. Water shall be furnished by Contractor and shall not be drafted from the Clark Fork River.

## 2.6 TOPSOIL

- A. Use topsoil that is loose, friable, loamy soil, free of excess acid and alkali. Assure topsoil does not contain objectionable amounts of sod, hard lumps, gravel, sub-soil or other undesirable material that would form a poor seedbed. Before striping topsoil, assure it has supported the growth of healthy crops, grass or other vegetable growth.

## 2.7 PERMEABLE TOPSOIL

- A. Combine topsoil defined in Section 02910 2.6 (A) with compost at a 50/50 ratio to create a permeable growth medium for vegetation.

## 2.8 SOILS FOR REPAIRS

- A. Use soil for filling and topsoiling repair areas of equal quality to the existing topsoil being repaired. Assure the soil is free of large stones, roots, stumps, or other materials that interfere with sowing, compacting, and establishing turf. Obtain approval from the Engineer before placing topsoil.

# **PART 3: EXECUTION**

## 3.1 TOPSOIL AND PERMEABLE TOPSOIL

- A. Place at least 4 inches of topsoil in all areas to be seeded. Import topsoil if sufficient topsoil is not available from excavated areas of the project.

## 3.2 ALLOWABLE HYDROSEEDING MONTHS

- A. Perform hydroseeding when the temperature and moisture are favorable to germination and plant growth. Hydroseed preferably before June 1<sup>st</sup> and after October 1<sup>st</sup> of each year. Seeding dates must be approved by the Engineer.

## 3.3 SEEDBED PREPARATION AND HYDROSEEDING

- A. Clear the areas to be seeded of all debris, vegetation, and other material determined by the Engineer to be detrimental to the preparation of a seedbed. Once the area is cleared, disc, harrow, rake, or work the area by other suitable methods, into a smooth, even seedbed. Assure the prepared seedbed surface is firm enough to prevent seed loss from high winds or normal rainfall. If rolling is required, perform rolling before seeding using a suitable roller, of a weight appropriate to the soil conditions.
- B. Hydroseeding Preparation: All slurry preparation shall be performed at the job site:

1. Water, mulch, fertilizer, binder and other ingredients shall be added to the tank simultaneously so that the finished load is a homogenous mix of the specified ingredients.
2. Seed shall be added last and shall be discharged within 2 hours. Loads held over 2 hours shall be recharged with ½ the seed rate before application.
3. Once fully loaded, the complete slurry shall be agitated for 3-5 minutes to allow for uniform mixing.

C. HydroSeeding Application: *One Step Hydroseed*

<u>Lbs/Ac</u>	<u>Material</u>
2,000 lbs	100% Cellulose or Wood Fiber
500 lbs	Fertilizer (2.06 Fertilizer 6-24-24)
---	Seed as per Section 02910 2.1 (C)

- D. All hydroseed applications are to be applied in a sweeping motion to form a uniform application and form a mat at the specified rates.
- E. Unused Loads. If mixture remains in tank for more than 8 hours it shall be removed from the job site at contractor's expense.
- F. Do not hydroseed in winds that prevent proper application into the surface.

### 3.5 CARE & CLEAN-UP OF HYDROSEEDED AREAS

- A. Hydro-Seeding Overspray. The Contractor is responsible for washing or otherwise cleaning excess material off all areas not intended to receive treatment.
- B. Keep the seeded area moist until it has germinated and its continued growth is assured. Prevent erosion during watering. The Contractor shall provide watering until seed is fully established. Water is incidental to the item "Seeding".
- C. Protect all seeded areas from traffic or pedestrian use with warning barricades or other Engineer approved methods.
- D. Replace any hydroseeded areas failing to germinate which have died or been damaged by construction activities. Replace such areas to meet the contract requirements. The contract warranty period of 2 years applies to this item.

**PART 4: MEASUREMENT AND PAYMENT**

**4.1 TOPSOIL AND PERMEABLE TOPSOIL**

- A. Measure topsoil and permeable topsoil by the cubic yard in its final position.
- B. Payment for topsoil and permeable topsoil will be according to the designed quantity as shown in the bid schedule unless it is determined by the Contractor and verified by the Engineer that errors exist in the original design that cause the pay item quantity to change by 10 percent or more. Payment will be full compensation for the work prescribed in this Section.
- C. Measurement and payment for hydroseeding shall be by the acre. Payment will be full compensation for the work prescribed in this section.

**END OF SECTION**

## SECTION 03210

### REINFORCING STEEL

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work is furnishing and placing reinforcing steel or wire fabric meeting the quality, type and size specified in the contract.

##### 1.2 REFERENCED

ASTM A-615	
ASTM A-705	
AASHTO M 31	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
AASHTO M 32	Cold Drawn Steel Wire for Concrete Reinforcement
AASHTO M 55	Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
AASHTO M 54	Fabric Deformed Steel Bar or Rod Mats for Concrete Reinforcement

#### PART 2: PRODUCT

##### 2.1 Furnish all new material meeting the following requirements.

###### A. Bar Reinforcement

1. Furnish deformed reinforcement steel meeting ASTM A 615, (AASHTO M 31) or ASTM A705, Grade 40 or Grade 60.
  - a. Small quantities purchased from warehouses may, at the Engineer's direction, be accepted if bend tested under ASTM A615 or AASHTO M31. The test specimen must cold bend around a pin without cracking on the outside of the bent portion.

###### B. Wire and Wire Mesh

1. Furnish wire meeting cold-drawn steel wire AASHTO M32 (ASTM A82) requirements.
2. Furnish wire mesh for concrete reinforcement meeting AASHTO M55 (ASTMA A 185).

3. Furnish bar mats meeting AASHTO M54 (ASTM A 184).

## **PART 3: EXECUTION**

### **3.1 PROTECTION**

- A. Protect steel reinforcement from damage at all times. Place steel free from dirt, detrimental scale, paint, oil and other foreign substance. Clean steel reinforcement having easily removed rust, loose scale, and dust using an approved method.

### **3.2 FABRICATION**

- A. Furnish four copies of shop details and placing drawings for all reinforcing steel to the Engineer for approval. Once checked, the Engineer will return two marked-up sets of prints or drawings for correction. The Engineer's review is only for general conformity with the plans. Checking the detailed dimensions is the Contractor's responsibility. The Engineer's review does not relieve the Contractor's responsibility to furnish all material meeting the Contract requirements. Detail Reinforcing, steel meeting the ACI "Standard Details and Detailing of Concrete Structures" and the "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures" published by the American Concrete Institute (ACI 315).
- B. Assure all bars are bent cold. Do not field bend any bar partially imbedded in concrete except as specified on the plans.
- C. Ship bar reinforcement in standard bundles, tagged and marked meeting the "Details and Detailing of Concrete Structures" (ACI 315) requirements.
- D. Concrete reinforcement and accessory details, not covered herein or on the drawings, must meet "Details and Detailing of Concrete Structures" and the "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures" (ACI 315 and 315R) requirements.

### **3.3 PLACING AND FASTENING**

- A. Accurately place and hold firm all steel reinforcement in the plan locations as concrete is being placed.
- B. Support and fasten together all reinforcement to prevent displacement due to construction loads. It is permissible to use on ground, where necessary, concrete support blocks having a minimum 4 square inches (2580 MM<sup>2</sup>) bearing area and having a compressive strength equal to the concrete being placed. Use approved bar chairs and spacers over form work. For concrete surfaces exposed to the weather in the finished structure, assure the portions of all accessories within ½

inch (12.7 mm) of the concrete surface are noncorrosive or protected against corrosion.

- C. Overlap welded wire fabric for successive mats or rolls providing an overlap measured between outermost cross wires of each fabric sheet at least 2 inches (50.8 mm). Extend the fabric across supporting beams and walls to within 4 inches (101.6 mm) of concrete edges. It may extend through contraction joints. Adequately support the fabric during concrete placement to maintain its position in the slab using the methods previously described or by laying the fabric on a concrete layer of the required depth before placing the upper slab layer.
- D. Offset vertical bars in columns at least one bar diameter at lap splices. Furnish templates for all column dowels.
- E. Obtain Engineer approval for all splices not shown on the plans. Mechanical connectors for reinforcing bars may be used if approved.
- F. Do not use pebbles, pieces of broken stone, concrete rubble, broken brick or building blocks, metal pipe, or wooden block to position the fabric.
- G. Follow the minimum concrete protective covering for reinforcement below.
  - 1. Concrete deposited against ground: 76.2 mm (3 inches)
  - 2. Formed surfaces exposed to weather or in contact with the ground:
    - a. #6 bars or larger 50.8 mm (2 inches)
    - b. Smaller than #6 bars 38.1 mm (1-1/2 inches)
  - 3. Interior Surfaces:
    - a. Beams, girders and columns 38.1 mm (1-1/2 inches)
    - b. Slabs, walls and joists:
      - 1) #11 bars or smaller 19.05 mm (3/4 inch)
      - 2) #14 and #18 bars 38.1 mm (1-1/2 inches)
- H. For corrosive atmospheres or fire protection, see special provisions for minimum covering requirements.
- I. Obtain Engineer approval of reinforcement placement before placing concrete. Remove and replace concrete placed without Engineer approval of reinforcing.
- J. Straighten fabric reinforcement shipped in rolls into flat sheets before placing it.

### 3.4 WELDING

- A. When specified or approved, weld reinforcing steel meeting “Reinforcing Steel Welding Code” (AWS D 1.4). Do not weld at bends in bars. Do not tack weld crossbars without Engineer approval.

## **PART 4: MEASUREMENT AND PAYMENT**

### 4.1 GENERAL

- A. Reinforcing steel used in the work is not measured. The cost of furnishing and placing reinforcing steel is incidental and included in the unit price or lump sum price bid for various items of the work.

**END OF SECTION**



## SECTION 03310

### STRUCTURAL CONCRETE

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. Furnish structural concrete meeting all specified requirements that is composed of Portland cement, aggregates, water. Furnish Ready-mixed concrete meeting ASTM C94 unless otherwise specified.

##### 1.2 REFERENCES

ASTM C-94	Standard Specification for Ready-Mixed Concrete
ASTM C-150	Specification for Portland Cement
ASTM C-618	Specification for Coal Flyash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C-989	Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C-595	Specification for Blended Hydraulic Cements
ASTM C-157	Performance Specification for Hydraulic Cements
ASTM C-33	Specification for Concrete Aggregates
ASTM C-260	Specification for Air-Entraining Admixtures for Concrete
ASTM C-494	Specification for Chemical Admixtures for Concrete
ASTM C-1017	Specification for Chemical Admixtures for Use in producing Flowing Concrete
ASTM D-98	
ASTM C-138	Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C-173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C-231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C-31	Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C-39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C-172	Practice for Sampling Freshly Mixed Concrete
ACI 301	Standard Specification for Structural Concrete for Buildings
ACI 305	Hot Weather Concrete
ACI 306	Cold Weather Concrete
ACI 318	Building Code Requirements for Reinforced Concrete

### 1.3 QUALITY ASSURANCE

- A. Codes and Standards: The codes and standards referred to in this section are declared to be part of this specification as if fully set forth herein. In addition, the following ACI Standards are incorporated in their entirety, unless specifically required otherwise:
1. ACI Standard 301, "Specifications for Structural Concrete for Buildings," American Concrete Institute, Edition.
  2. ACI Standard 318, "Building Code Requirements for Reinforced Concrete", American Concrete Institute, current edition.
  3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
  4. International Building Code of I.C.B.O.
- B. Concrete Testing: The Contractor shall employ at his expense an independent testing agency acceptable to the engineer to perform material evaluation tests and/or perform the mix design prior to placing any concrete. The independent testing agency will perform all acceptance testing during the onsite placement of the concrete. Retesting or additional testing of concrete or materials failing to meet the requirements of these specifications shall be done by the Contractor at no additional cost to the Owner.

## PART 2: PRODUCT

### 2.1 CLASSIFICATION

- A. Concrete is classified as set forth below. Place the specified class of concrete for each structure element as specified. Concrete with prefixes "C" contain 1-1/2 inch (38.1 mm) size aggregate and those with "M" contain 3/4 inch size aggregate. Concrete with prefixes "M" may be substituted for concrete with prefixes "C". *Unless otherwise noted in the Contract Documents, all concrete shall be M-4000.*
1. Use M-4000 concrete for curb and gutter, sidewalks, driveways, approaches, curb turn fillets and valley gutters and structural concrete.
  2. Use M-3000 concrete for manholes, storm drain inlets and miscellaneous or C-3000 Concrete Construction class.

3. M-3000 is concrete with 3/4 inch maximum aggregate and a 28-day compressive strength of 3000 pounds per square inch (psi).
  4. M-4000 is concrete with 3/4 inch maximum aggregate and a 28-day compressive strength of 4000 pounds per square inch (psi).
  5. C-3000 is concrete with 1-1/2 inch maximum aggregate and a 28-day compressive strength of 3000 psi.
- B. If concrete strength or durability requirements established by design exceed the above strength classifications, the Engineer may specify additional concrete classifications to meet those requirements.

## 2.2 COMPOSITION OF CONCRETE

- A. Upon receipt of the notice of award of the contract, furnish the Engineer with names of suppliers and locations of sources of materials proposed for use.
1. Materials
    - a. Cementitious Material: Cementitious material consists of Portland cement meeting ASTM C 150, with or without the addition of cementitious or pozzolanic mineral admixtures meeting, ASTM C618 or ASTM C989, or blended hydraulic cement meeting ASTM C595 or ASTM 1157. Unless otherwise specified, assure cementitious material meets ASTM C 150 Type I or Type II. Assure cementitious material used in concrete is the same brand and type and from the same plant of manufacture as the cementitious material used in the concrete represented by the submitted field test data or used in the trial mixtures.
    - b. Aggregates: Assure aggregates meet ASTM C33. When a single size or a combination of two or more sizes of coarse aggregates are used, assure the final gradation meets the grading requirements of ASTM C33. Obtain concrete aggregates from the same source and use the same size ranges as the aggregates used in the concrete represented by submitted historical data, or used in trial mixtures.
    - c. Water and Ice: Use concrete mixing water and water to make ice meeting requirements of ASTM C94.
    - d. Admixtures: Use admixtures meeting the following requirements:
      - 1) Air entraining, admixtures - ASTM C260
      - 2) Chemical admixtures - ASTM C494
      - 3) Chemical admixtures for use in producing, flowing concrete - ASTM C1017

- 4) Calcium Chloride - ASTM D98
- 5) Use admixtures in the concrete that are the same as those used in the concrete represented by submitted field test data or in trial mixtures.

2. Change of materials

- a. When brand, type, size, or source of cementitious materials, aggregates, water, ice or admixtures are requested to be changed, submit new field data or data from new trial mixtures or furnish evidence that indicates that the change will not adversely affect the relevant properties of the concrete for acceptance before using the concrete.

B. Performance and Design Requirements

1. Assure the cementitious material content is adequate to meet the specified requirements for strength, water-cement ratio and finishing requirements. For concrete used in floors, assure the cement content is at least that indicated in Table 2.1. Acceptance of a lower cement content is contingent upon verification that concrete mixtures with a lower cement content will meet the specified strength requirements and will produce concrete with equal finish quality, appearance, durability, and surface hardness. When a history of finishing quality is not available, evaluate the proposed mixture by placing concrete in a slab at the job using job materials, equipment and personnel. Assure the slab is at least 8 feet (2.4 m) square and has an approved thickness. Slump cannot exceed the specified slump. Submit evaluation results for acceptance.

**TABLE 2.1**  
**MINIMUM CEMENT CONTENT REQUIREMENTS**

Nominal Maximum size of aggregate, in (mm)	Minimum cement content lb/yd <sup>3</sup> (kg/m <sup>3</sup> )
1-1/2 (38-1)	470* (163.0)
1 (25.4)	520 (180.3)
3/4 (19-05)	540 (187-3)
3/8 (9-5)	641 (222.3)

\* Minimum cement content is 520 lb/yd<sup>3</sup> and maximum H<sub>2</sub>O/cement ratio of 0.45 if concrete will be exposed to freezing and thawing and/or in the presence of deicing chemicals.

2. Furnish concrete at the point of delivery having a slump of 4 inches (max) determined by ASTM C 143. Meet slump tolerances in ACI 117. When a plasticizing admixture is used meeting ASTM C 10 17 or when a Type F

or G high range water reducing admixture meeting ASTM C494 is approved to increase the concrete slump, assure the concrete has a slump of 2 to 4 inches before the admixture is added and a maximum slump of 8 inches at the point of delivery after the admixture is added.

3. Assure the nominal maximum size of coarse aggregate does not exceed three fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms or one-third of the thickness of slabs or toppings.
4. Concrete must be air entrained. Measure air content under ASTM C 138, C 173 or C231. Unless otherwise specified, ASTM C231 shall be used.

**TABLE 2.2**  
**TOTAL AIR CONTENT\* OF CONCRETE**  
**FOR VARIOUS SIZES OF COARSE AGGREGATE**

Nominal maximum Size of aggregate mm, (in.)	Total air content, percent		
	Severe exposure	Moderate exposure	Mild exposure
Less Than 9.53 (3/8)	9	7	8
9.53 (3.8)	7.5	6	4.5
12.7 (½)	7	5.5	4
19-05 (3/4)	6	5	3.5
25.4 (1)	6	4.5	3
12.7 (1-1/2)	5.5	4.5	3
50.8 (2)	5	3.5	1.5
76.2 (3)	4.5	3.5	1.5
152.4 (6)	4	3	1

\* Measure in accordance with ASTM C 138, C 173, or C 231.  
Air content tolerance is +/- 1 - 1 ½ percent

- a. When admixtures are specified in the Contract documents for particular parts of the work, use types specified. Use of calcium chloride or other admixtures containing chloride ions is subject to the limitations in Table 2.3 Chloride Ion Concentration. When approved, use calcium chloride in solution form only, when introduced into the mixture.
  - 1) Assure the maximum water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days attributed to the ingredients including water, aggregates, cementitious materials and admixtures do not exceed the limits of Table 2.3. Use tests to determine water soluble chloride ion content meeting AASHTO T260. The

type of member described in Table 2.3 applies to the work as indicated in the Contract Documents.

**TABLE 2.3**  
**MAXIMUM ALLOWABLE CHLORIDE ION CONTENT**

Type of Member	Maximum water soluble chloride (Cl) Content in concrete, percent by weight of cement
Prestressed concrete	0.06
Reinforced concrete exposed to chloride in service	0.15
Reinforced concrete that will be dry or protected from moisture in service	1.00
Other reinforced concrete construction	.30

- b. When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40°F (40°C) for more than three successive days, deliver concrete in accordance with ASTM C-94.
- c. Furnish the compressive strength and the water-cement or water cementitious, material ratio of concrete for each portion of the work as specified in the Contract documents.
  - 1) If cementitious or pozzolanic mineral admixtures meeting, ASTM C618 or ASTM C989 are used, the cement portion of the water-cement ratio must be the total weight of cementitious material.
  - 2) The maximum weight of fly ash, pozzolan or ground granulated blast-furnace slag included in the calculation of water-cementitious material ratio cannot exceed the following percentages of the total weight of Portland cement plus fly ash, pozzolan and ground granulated blast-furnace slag:
    - 3) The combined weight of fly ash and pozzolan meeting ASTM C618 cannot exceed limits in ACI 318. The fly ash and pozzolan present in an ASTM Type IP or IPM blended cement meeting ASTM C595 must be included in the calculated percentage.
    - 4) The weight of ground granulated blast-furnace slag meeting ASTM C989 cannot exceed 50 percent of the total weight

of cementitious material. The slag used in manufacture of a Type IS or ISM blended hydraulic cement meeting ASTM C595 must be included in the calculated percentage.

- 5) If fly ash or pozzolan is used in concrete with ground granulated blast-furnace slag, the Portland cement constituent meeting ASTM C 150 cannot be less than 50 percent of the total weight of cementitious material. Fly ash or pozzolan must not constitute more than 25 percent of the total weight of cementitious material.
- 6) Strength requirements are based on the 28-day compressive strength determined on 6" x 12" (150mm x 300mm) cylindrical specimens made and tested under ASTM C31 and C39 respectively.

## 2.3 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs.
- B. Submit written reports of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and approved.

## PART 3: EXECUTION

### 3.1 CONCRETE MIXES

- A. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch match mixer. For mixers of one cu. Yd., or small capacity continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cubic yard, increase minimum 1-1/2 minutes of mixing time by 2.5 minutes for each additional cu. yd., or fraction thereof.
- B. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, batch quantities, and amount of water introduced.
- C. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.

- D. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ANSI/ASTM C94 may be required.
- E. When air temperature is between 85°F (30°C) and 90°F (32°C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.

### 3.2 CONSISTENCY

- A. Assure concrete is of such consistency that it will flow around reinforcing steel, but individual particles of the coarse aggregate, when isolated, show a coating of mortar containing its proportionate quantity of sand. The consistency of the concrete will be gauged by the ability of the equipment to properly place the concrete in its final position and not by the difficulty in mixing or transporting. Use the minimum quantity of mixing water necessary to provide workability within the ranges of slump specified.

### 3.3 MIXING

- A. Thoroughly mix concrete to assure a uniform distribution of the materials throughout the mass. Mix concrete only in quantities required for immediate use and place it within the time limits specified. Waste all concrete which initial set has begun. Retempering of concrete is prohibited. Aggregates, or bags of cement containing lumps or crusts of hardened material shall not be used. Mix Concrete in an approved truck mixer meeting the requirements of ASTM C94 herein.
- B. The capacity of the plant and the transportation equipment must ensure delivery at a rate that will permit proper handling, placement and finishing at the point of delivery. Maintain the concrete delivery rate to provide for the continuous operation of placing, handling and finishing concrete as is practical. Maintain the interval between delivery of loads so that layers or lifts of concrete in place do not harden before succeeding layers or lifts are placed. In general, no lift or layer of concrete can remain exposed for more than 20 minutes before being covered by fresh concrete.
- C. The volume of mixed concrete in the mixing drum shall not exceed the manufacturer's rating, on the capacity plate.
- D. During freezing weather, other approved methods of measuring water will be permitted.
- E. A recording water metering device is always required at the primary point of the batching operation.



- F. Do not add water to concrete in transit. Water may be introduced into the mixer at the job site under direction of the Engineer, if the specified water-cement ratio is not exceeded. Water must be added in accordance with ASTM C94. Assure the drum revolves continuously after the introduction of the cement and water until the concrete is discharged.
- G. Begin mixing immediately after introduction of the cement and water and continue for at least 70 revolutions of the drum at mixing speed. This minimum revolution count will be waived when the concrete is produced at a central mixing plant. Not more than 100 drum revolutions can exceed 6 revolutions per minute. All other revolutions must be at agitating speed of not less than 2 or more than 6 revolutions per minute.
- H. Discharge the concrete at the job and place in its final position within 1 - ½ hours after the introduction of the mixing water and cement. When the air temperature is 90°F (30°C) or above, place the concrete in its final position within 1 hour after the introduction of the mixing, water and cement. Concrete mixes with an approved set retarding admixture may be held an additional ½ hour beyond limits specified above.
- I. No mixed or agitated concrete that has remained in the drum of the truck mixer more than 10 minutes without agitation can be used. If the Engineer determines the concrete has not suffered any detrimental effects. It may be used, after remixing for a minimum of 20 revolutions of the drum at mixing speed, if it can still be placed in the forms within the specified time limits.
- J. Provide a revolution counter on each truck that registers the number of revolutions of the drum.
- K. Mount the counter so it can be easily read by both the operator and the Engineer.

### 3.4 PLACING CONCRETE

- A. Thoroughly compact concrete into its final position. Assure it is thoroughly consolidated around fittings and embedded items. Assure all reinforcement and embedded items are accurately placed as shown on the plans and are clean and free from coatings of dried mortar, detrimental rust, scale, oil or foreign matter. Place concrete meeting the applicable requirements of Sections 02528 and 02529.

### 3.5 CURING CONCRETE

- A. Thoroughly cure concrete surfaces subject to premature drying by covering as soon as possible with canvas, plastic sheets with sealed joints, burlap and sand or other satisfactory materials and keep concrete moist. If the concrete surfaces are not covered, keep them moist by flushing or sprinkling. Continue curing for at

least 7 days after placing the concrete. Concrete surfaces placed against forms may be cured by leaving the forms in place for at least 7 days, when approved.

- B. Protect concrete against freezing or other conditions detrimental to strength development meeting the applicable requirements of this specification.
- C. To aid finishing, side forms on ornamental work, curbs and sidewalks, railing and parapets may be removed after 12 hours, not to exceed 48 hours, depending on weather conditions. Continue moist curing during the concrete finishing operation.
- D. Untreated forms and existing concrete must be kept continuously wet for at least 1 hour before any concrete is placed. Keep wet until covered with concrete except that adequately treated forms must be thoroughly washed with a water spray immediately before placing the concrete.
- E. The curing of concrete, by either water curing or membrane curing, must be as follows unless otherwise approved by the Engineer.

1. Water Curing

- a. Keep all concrete top surfaces continuously moist after finishing, with a fine water spray, until the concrete has set. Cover the moist concrete with water or an approved curing covering.
- b. Cure concrete deck slabs and concrete floors for at least 7 days. Cure by placing burlap, cotton mats or other absorptive material as close behind the finishing operation as possible without marring the finished surface. Keep the absorptive material continuously moist for the full time it is used. The absorptive material may be kept in place for the entire curing period or it may be removed as soon as practical and the entire surface covered with approximately 1-1/2 inches (38.1 mm) of sand, kept continuously moist for the entire curing period.
- c. Remove forms and repair surface irregularities without interfering with any of the curing requirements. As soon as the vertical forms have been removed and the surface irregularities repaired, cover the concrete with absorptive material, kept continuously wet for the balance of the curing a period.

2. Impervious Membrane Curing

- a. Assure membrane curing compounds are delivered to the job in the manufacturer's original container, clearly labeled to show the

name of the manufacturer and the contents. The clear curing compound must be sufficiently transparent and free from permanent color that would change the color of the natural concrete. Use clear compound containing a fugitive dye having color sufficient to render the film visible on the concrete for at least 4 hours after application. The concrete surface must maintain its natural color after curing.

- b. Use a compound ready for use as shipped by the manufacturer. Dilute following the manufacturer's recommendations. Use curing compound only with written approval. Sampling will not be required if manufacturer's certification is available. Apply the curing compound under pressure with a spray nozzle to cover the entire exposed surface thoroughly and completely with a uniform film not exceeding manufacturer's specifications. Maintain the required pressure in the spray machine to force the material to leave the nozzle in a fine mist. Keep all concrete surfaces moist with a fine water spray or with wetted burlap until the sealing compound is applied. Keep the curing compound application close to the finishers of the top surface of concrete at all times. Seal the concrete immediately after the finishing operations have been completed, to the satisfaction of the Engineer.
- c. If it is necessary to allow workers or equipment on the surface before the 7 day curing period is completed, cover the top surface of sealed concrete with a protective cushion for runways. Use a cushion consisting of a moist, 1-inch (25mm) minimum thick layer of fine sand, or layers of moist burlap that will prevent damage to the finished concrete. Cover the approved cushion with four by eight foot sheets of 3/4 inch (19mm) plywood laid over the cushion. Do not place the cushion material for at least 8 hours after the final application of the curing compound. Obtain the Engineer's written approval for any other proposed cushion material before use. Layers of plastic, visqueen or canvas are not an acceptable cushion material.
- d. Keep concrete, which has not completed its curing period, continuously moist during the stripping and surface repair operations. Remove all surface irregularities, repair all depressions, voids or holes, including those formed by trapped air, to the satisfaction of the Engineer. Immediately apply the curing compound before the surface has had an opportunity to dry out. Keep concrete, from which forms have been stripped, continuously moist until surface repair and finishing are completed and the impervious membrane curing has been applied.

### 3.6 WEATHER AND NIGHT LIMITATIONS

#### A. General

1. Stop concreting operations when darkness prevents obtaining the specified placing, and finishing work. Night operations may be conducted with written approval and when approved artificial lighting is provided.
2. Cold weather concreting is governed by ACI 306 unless otherwise specified herein. Hot weather concreting methods is governed by ACI 305 unless otherwise specified herein. Except by specific written authorization, stop concreting operations when a descending air temperature in the shade and away from artificial heat falls below 40°F (4°C), or do not resume until an ascending air temperature in the shade and away from artificial heat reaches frozen foundation course or subgrade.
3. Assume all risk of placing concrete in cold weather. Placing concrete during cold weather does not relieve the Contractor of the responsibility for obtaining the specified results. Remove and replace all concrete injured by frost at Contractor expense.
4. Before any concrete is placed, remove all ice, snow and frost completely from the formwork receiving the concrete.
5. Heating and Placing Concrete
  - a. When concreting is authorized during cold weather, assure concrete temperature meets ASTM C94.
6. Protection of Concrete
  - a. During the curing period, if the air temperature is anticipated to fall below 32°F (0°C), provide an approved blanket type insulating material along the work for covering all concrete that has been in place for 7 days or less. If, at any time, the ambient temperature drops to 32°F (0°C) or less, protect the concrete using a method approved by the Engineer. The minimum method of protection under such conditions is as follows: between two layers of plastic sheeting, the insulating materials, with the exception of commercial blankets, must be spread loosely to a minimum depth of 6 inches (150mm), but in all cases, to the depth required to prevent freezing of, or frost damage to, the concrete. Maintain the blanketing material at least until the end of the regular specified curing, period which is not less than 7 days. The Engineer may direct leaving the blanketing material in place for an additional period if the recorded temperatures indicate that additional curing

may be necessary. If during the construction period the mean daily temperature is expected to fall below 40°F (4°C) for 3 consecutive days, furnish approved heating enclosures and devices capable of maintaining the surface temperature of the concrete in place between 55°F (13°C) and 80°F (26°C). The curing, period under these conditions is 7 days when Type I-II cement is used and 5 days when a pre-approved “high early strength” mix is used. At the close of the curing period, the heat may be reduced so that the temperature inside the housing does not decrease faster than 15° per hour until the temperature inside the housing is the same as outside.

- b. A Contractor may, at their own expense, field cure concrete cylinders with their in-place concrete and discontinue protection when those field cylinders reach 70 percent of design strength as indicated by the 28 day requirement of these specifications.
- c. Perform all concrete protection using methods consistent with ACI-306-1-87 and approved by the Engineer.

### 3.7 TESTING

- A. All concrete must be tested by an ACI Grade I or equivalent certified testing technician.
  - 1. Materials
    - a. The Engineer or their representative must have access to the ready mix production facility for sampling constituent materials during production to assure the materials meet these specifications and represent those stated on the approved mix design.
  - 2. Standard Slump Tests
    - a. A slump test will be made each time that strength specimens are made. Slump tests are performed meeting ASTM C143 “Method of Test for the Slump of Portland Cement Concrete”.
  - 3. Compression Tests
    - a. A minimum of three specimens 6 inch (150 mm) in diameter, shall be made and tested for every concrete placement. Mold and test one set of test cylinders for every 50 yards (76.5 cubic meters) of concrete or fraction thereof placed each day. On a given project, if the total volume of concrete is such that frequency of testing required above would generate less than 5 strength tests for a given class of concrete, make tests from at least 5 randomly selected

batches or from each batch if fewer than 5 batches are used. Cure these cylinders under laboratory conditions except that additional test cylinders cured entirely under field conditions may be required by the Engineer to check the adequacy of curing and protection of the concrete.

- b. Take samples for strength tests in accordance with ASTM C172, entitled "*Practice for Sampling Freshly Mixed Concrete*".
- c. Mold test cylinders and laboratory-cure in accordance with ASTM C31. Test cylinders in accordance with ASTM C39, entitled "Method of Test for Compressive Strength of Cylindrical Concrete Specimens", ASTM C39, using an independent testing laboratory, as approved by the Engineer.
- d. Of each of the 3 cylinders take for a pour, test 1 for information strength at 7 days and test 2 for acceptance strength at 28 days. To meet this specification, average strength of two cylinders from the same sample, tested at 28 days or the specified earlier age, is required for each strength test. Strength level of an individual class of concrete is considered satisfactory if both of the following requirements are met:
  - 1) The average of all sets of 3 consecutive tests equal or exceed the specified strength.
  - 2) No individual strength test (average of two cylinders) falls below specified strength by more than 500 psi (3400 kPa).
- e. Cure field cured cylinders under field conditions meeting Section 7.4 of "Method of Making and Curing Concrete Test Specimens in the Field" (ASTM C31).
- f. Mold field cured test cylinders at the same time and from the same samples as laboratory cured test cylinders. Improve procedures for protecting and curing concrete when strength of field cured cylinders at the test age designated for measuring specified strength is less than 85 percent of that of companion laboratory cured cylinders. When laboratory cured cylinder strengths are appreciably higher than the specified strength, field cured cylinder strengths need not exceed the specified strength by more than 500 psi even though the 85 percent criterion is met.
- g. The strengths of any specimens cured on the job are to indicate the adequacy of protection and curing of the concrete and may be used to determine when the forms may be stripped, shoring removed or the structure placed in service. When the strengths of the job cured specimens are below those specified above, the Contractor must

improve the procedures for protecting and curing the concrete.

- h. When concrete fails to meet the requirements above or when tests of field cured cylinders indicate deficiencies in protection and curing, the Owner's representative may order tests on the hardened concrete under Chapter 17.3 of ACI-301-84 or order load tests in Chapter 20 of the ACI Building Code (ACI 318-83) for that portion of the structure where the questionable concrete has been placed. In the event the load or core tests indicate that the structure is unsatisfactory, make all modifications as directed by the Engineer to make the structure sound. If the load or core tests indicate the concrete is satisfactory, all cost of testing shall be paid by Owner.

4. Air Content Tests

- a. The Engineer shall during each strength test, check the air content by either the "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C231), "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" (ASTM C173) or "Method of Test for Unit Weight, Yield and Air Content (Gravimetric) of Concrete" (ASTM C138).

5. Temperature

- a. Test hourly when air temperature is 40°F (4°C) and below, and when 80°F (27°C) and above; and each time a set of compression test specimens is made.

**PART 4: MEASUREMENT AND PAYMENT**

4.1 GENERAL

- A. Structural concrete used in the work is not measured. The cost of furnishing and placing structural concrete is incidental and included in the unit price or lump sum price bid for various items of the work.

**END OF SECTION**

## **SECTION 03440**

### **ARCHITECTURAL WALL TREATMENT AND ANTI-GRAFFITI COATING**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This Section contains requirements for the architectural form liner and anti-graffiti coating that shall be applied to the precast concrete panels for retaining walls located at the MRL Bridge 113.1 crossing as shown in the Drawings.

##### **1.2 SUBMITTALS**

- A. Design Mixtures: Refer to Section 03310, Structural Concrete.
- B. A minimum of 21-days prior to proceeding with the work, submit the following to the Engineer for approval:
  - 1. Manufacturer's catalogue cuts (two copies) of the proposed form liner, including bonding and release agents, and anti-graffiti coating.
  - 2. One 3-ft x 3-ft liner sample of the proposed form liner.
  - 3. Manufacturer's instructions on the handling, installation, and removal of the form liner.

#### **PART 2: PRODUCTS**

##### **2.1 GENERAL**

- A. Furnish all materials and equipment required to complete the architectural form liner and anti-graffiti coating work.
- B. Maximum depth of fractured fins is  $\frac{3}{4}$ " from outside edge of concrete.
- C. Use form liner style pattern No. 1101  $\frac{3}{4}$ " deep fractured fin. manufactured by Spec Formliners, Inc., 530 East Dyer Road, Santa Ana, CA, 92707, Phone: 714-429-9500, or equal as approved by the Engineer.
- D. Furnish a permanent, non-sacrificial siloxane-based anti-graffiti coating capable of withstanding multiple cleanings. Coatings must allow graffiti to be removed through the use of a water pressure washer and without detergents or chemicals.



Product must be approved by the manufacturer for use on a concrete surface and have a finished dry film thickness of not less than 6 mils (0.150 mm).

- D. Refer to Section 03310, Structural Concrete, for concrete mix design, reinforcement, and material requirements.

## **PART 3: EXECUTION**

### **3.1 INSTALLATION**

- A. If precasting the panels at the project site, construct at the project site a 3-foot square sample section of the textured concrete surface, including the rustication border around the sample section perimeter as shown on the plans. The sample will serve as the basis for approving the work. The Engineer will review the sample for texture, consistency and overall workmanship. Maintain the sample on site throughout construction until the work has been approved by the Engineer. If casting at a precast concrete fabrication plant, the sample shall be created in the same manner as in the field.
- B. Use form liners in accordance with the manufacturer's instructions and as detailed on the plans. Seal all joints and tie holes to prevent localized water loss and subsequent discoloration of the concrete. Recommendations on sealing formwork are contained in ACI 347-68.
- C. Maintain minimum clearances as detailed on the Drawings. Place and vibrate concrete to avoid trapped air, honeycombing and surface blemishes. Where form liners are used on sloped or inclined surfaces, subject to approval of the Project Manager, neat edged, circular openings may be provided in form liner sufficiently large to allow insertion of vibrator and to permit escape of trapped, free air.
- D. Following removal of form liners, repair rock pockets, offsets at form joints greater than 1/4", air holes and voids greater than 1/2", and projections or depressions due to form ties greater than 1/4".
- E. Clean the liner prior to each re-use to prevent matrix build-up on the surface. Blow or wipe off excess release agent before the form liner is reused. Do not use damaged form liners.
- F. Apply anti-graffiti coating to all concrete surfaces above finish grade on the MRL Bridge 113.1 crossing retaining wall, including those for which use of form liners was not required.

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## **PART 4: MEASUREMENT AND PAYMENT**

### **4.1 GENERAL**

- A. The architectural form liner treatment and anti-graffiti coating used in the work is not measured. The cost of furnishing and applying architectural form liner treatment and anti-graffiti coating is incidental and included in the unit price or lump sum price bid for various items of the work.

**END OF SECTION**

## SECTION 03450

### ARCHITECTURAL PRECAST CONCRETE CAPS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following:

1. Architectural precast caps.

##### 1.2 DEFINITION

- A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, pre-approved by Architect.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

- B.
1. Loads: As indicated.

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners and specialty details required due to conditions indicated.
- D.
1. Comprehensive engineering analysis certified by the qualified professional engineer responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.
- E. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three (3), illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
- F. Welding certificates.

- G. Material test reports: For aggregates.
- H. Material Certificates: Signed by manufacturers.
- I. Field quality-control test and special inspection reports.

## 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Pre-stressed Concrete," applicable to types of architectural precast concrete units indicated.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."

## PART 2 - PRODUCTS

### 2.1 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

### 2.2 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
- B.
  - 1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.
- C. Supplementary Cementitious Materials:
- D.
  - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
  - 2. Metakaolin Admixture: ASTM C 618, Class N.

3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
  4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- E. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- F.
1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
    - a. Gradation: Uniformly graded.
  2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.
- G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

## 2.3 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
- C. Carbon-Steel Plate: ASTM A 283/A 283M.
- D. Malleable Iron Castings: ASTM A 47/A 47M.
- E. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30.
- F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
- G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65.
- I. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
- J. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.
- K. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436.
- L. Shop-Primed Finish: As specified in individual specification sections.

## 2.4 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144, or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

## 2.5 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B.
  - 1. Limit use of fly ash and silica fume to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.
- C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- E. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
- F.
  - 1. Compressive Strength (28 Days): 5000 psi minimum.
- G. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- H. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- I. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

## 2.6 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
- B.
  - 1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.
- D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

- E. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- F. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- G. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- H. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
- I.
  - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
- K.
  - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- M. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.
- N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and Architect's visual and appearance requirements approved by samples, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

## 2.7 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

## 2.8 FINISHES

- A. Basis of Design:
  - 1.
  - 2. CI 301

- 3. Color: Brown
- 4. Texture: Acid Etched
- B. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match Architect approved sample panels and as follows:
- C.
  - 1. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated or if not indicated as selected by the Architect.
- D. Finish exposed to view top, bottom, side and end surfaces of architectural precast concrete units to match face-surface finish.
- E. Finish unexposed surfaces of architectural precast concrete units by float finish.

## 2.9 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
- C.
  - 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  - 2. Unless otherwise indicated, provide for uniform joint widths of ½ inch.
- D. Connect architectural precast concrete units in position by welding, grouting, or as otherwise indicated and approved on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- E. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
- F. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.



- G. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

### 3.2 FIELD QUALITY CONTROL

- A. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- B. Testing agency will report test results promptly and in writing to Contractor and Architect.
- C. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.3 REPAIRS

- A. Repair damaged architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements. Rejected items shall be removed and replaced at no additional expense.
- B. Mix approved patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of ten (10) feet.
- C. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

### 3.4 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
- C.
  - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

## **PART 4 - MEASUREMENT AND PAYMENT**

### 4.1 PRECAST CONCRETE CAP

- A. This item is measured and paid for by the lineal feet of precast concrete cap in place at the contract unit price bid. Price and payment is full compensation for all materials, equipment,

tools, labor, and for the performance of all work and incidentals necessary to complete the item. The lineal feet measurement is the horizontal distance measured along the inside edge of the cap.

**END OF SECTION**

**SECTION 04213**  
**BRICK MASONRY**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. Face brick.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For each type and color of brick and colored mortar.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Material Certificates: For each type and size of product indicated.

**1.4 QUALITY ASSURANCE**

- A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- B. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.
  1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches long by 36 inches high by full thickness.

**1.5 PROJECT CONDITIONS**

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## **PART 2 - PRODUCTS**

### **2.1 MASONRY UNITS, GENERAL**

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

### **2.2 BRICK**

- A. Regional Materials: Brick shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. General: Provide shapes indicated and as follows.
  - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  - 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- C. Face Brick: Facing brick complying with ASTM C 216.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Robinson Brick. New Traditions – Dartmouth.
  - 2. Grade: SW.
  - 3. Type: FBA.
  - 4. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
  - 5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
  - 6. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.
  - 7. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.

## 2.3 MORTAR MATERIALS

- A. Regional Materials: Aggregate for mortar shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Capital Materials Corporation; Flamingo Color Masonry Cement.
    - b. Cemex S.A.B. de C.V; Brikset Type N.
    - c. Holcim (US) Inc; Mortamix Masonry Cement.
    - d. Lafarge North America Inc; Lafarge Masonry Cement.
    - e. Lehigh Cement Company;
    - f. National Cement Company, Inc; Coosa Masonry Cement.
- F. Aggregate for Mortar: ASTM C 144.
  - 1. White-Mortar Aggregates: Natural white sand or crushed white stone.
- G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ACM Chemistries; RainBloc for Mortar.
    - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
    - c. Grace Construction Products; W.R. Grace & Co. -- Conn; Dry-Block Mortar Admixture.

## 2.4 REINFORCEMENT

- A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
- B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- diameter, hot-dip galvanized, carbon-steel continuous wire.

## 2.5 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
  - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
- B. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
  - 1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
  - 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch- diameter, hot-dip galvanized steel wire.
  - 3. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick, steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch of masonry face.

## 2.6 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" Section 076200 "Sheet Metal Flashing and Trim" and as follows:
  - 1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
- B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07620 "Sheet Metal Flashing and Trim."
- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene or PVC.

- B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- C. Weep/Vent Products: Use one of the following unless otherwise indicated:
1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Advanced Building Products Inc; Mortar Maze weep vent.
      - 2) BLOK-LOK Limited; Cell-Vent.
      - 3) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
      - 4) Heckmann Building Products, Inc; No. 85 Cell Vent..
      - 5) Hohmann & Barnard, Inc; Quadro-Vent.
      - 6) Wire-Bond; Cell Vent.
  2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Mortar Net USA, Ltd; Mortar Net Weep Vents.
  3. Vinyl Weep Hole/Vent: One-piece, offset, T-shaped units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hohmann & Barnard, Inc; #343 Louvered Weep Hole.
      - 2) Williams Products, Inc; Williams-Goodco Brick Vent.
      - 3) Wire-Bond; Louvered Weepholes.
- D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Advanced Building Products Inc;
  - b. CavClear/Archovations, Inc; Stone Mat.
  - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
  - d. Mortar Net USA, Ltd; Mortar Net.
2. Provide one of the following configurations:
  - a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep.
  - b. Strips, not less than 3/4 inch thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
  - c. Sheets or strips full depth of cavity and installed to full height of cavity.

## 2.8 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Diedrich Technologies, Inc.
    - b. EaCo Chem, Inc.
    - c. PROSOCO, Inc.

## 2.9 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  1. Do not use calcium chloride in mortar.
  2. Use portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.
  3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.



- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide Type N unless another type is indicated.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

### **3.2 TOLERANCES**

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
  - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
  - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch; do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick as follows:
  1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  2. With entire units, including areas under cells, fully bedded in mortar at starting course on footings.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

### 3.5 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to concrete where masonry abuts or faces structural concrete to comply with the following:
  1. Provide an open space not less than 1 inch wide between masonry and concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

### 3.6 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  2. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
  3. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
- C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
  1. Use specified weep/vent products to form weep holes.
  2. Space weep holes 24 inches o.c. unless otherwise indicated.
- D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products or open head joints to form vents.
  1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

### 3.7 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas,

as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

- B. Inspections: Level 1 special inspections according to the "International Building Code."
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

### 3.8 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes
  - 2. Protect adjacent surfaces from contact with cleaner.
  - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 4. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."
  - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
  - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

### 3.9 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

## **PART 4 - MEASUREMENT AND PAYMENT**

### **4.1 TUMBLER BRICK VENEER**

- A. This item is measured and paid for by the square feet of tumbled brick veneer in place at the contract unit price bid. Price and payment is full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item. The square feet measurement is the area measured to a maximum of 1 foot below finish grade, or as otherwise shown on the plans.

**END OF SECTION**

## **SECTION 06160**

### **SHEATHING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Roof sheathing.
  - 2. Composite nail base insulated roof sheathing.

##### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.
  - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.

##### **1.3 INFORMATIONAL SUBMITTALS**

- A. Evaluation Reports: For following products, from ICC-ES:
  - 1. Preservative-treated plywood.
  - 2. Fire-retardant-treated plywood.
  - 3. Foam-plastic sheathing.

#### **PART 2 - PRODUCTS**

##### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

## 2.2 WOOD PANEL PRODUCTS

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
  - 1. Plywood.
  - 2. Oriented strand board.
  - 3. Particleboard underlayment.
  - 4. Hardboard underlayment.
- C. Plywood: DOC PS 1 unless otherwise indicated.
- D. Oriented Strand Board: DOC PS 2.

## 2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC3b for exterior construction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat all plywood unless otherwise indicated and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing].

## 2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  - 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
  3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.
  - D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
  - E. Application: Treat plywood indicated on Drawings.

## 2.5 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exterior sheathing.
- B. Oriented-Strand-Board Roof Sheathing: Exposure 1 sheathing.

## 2.6 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

- A. Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation with oriented strand board laminated to one face complying with ASTM C 1289, Type V.
  1. Polyisocyanurate-Foam Thickness: As indicated.
  2. Oriented-Strand-Board Nominal Thickness: As indicated.
- B. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation complying with ASTM C 1289, Type II, Class 1, with oriented strand board adhered to spacers on one face.
  1. Polyisocyanurate-Foam Thickness: As indicated.
  2. Oriented-Strand-Board Nominal Thickness: As indicated.
  3. Spacers: Wood furring strips or blocks not less than 3/4 inch thick and spaced not more than 12 inches o.c.
- C. Erelayment: ANSI A135.4, Class 4 (Service), Surface S1S; with back side sanded.

## 2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.



## 2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Paper-Surfaced Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Division 07 Section "Joint Sealants."
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
  - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.
- C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

## 2.9 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
  - 1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

# PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.

2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
  3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

### 3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
1. Roof Sheathing:
    - a. Nail to wood framing.
    - b. Screw to cold-formed metal framing.
    - c. Space panels 1/8 inch apart at edges and ends.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 GENERAL

- A. This item is measured and paid for by the square foot of sheathing in place at the contract unit price bid. Price and payment is full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item.

**END OF SECTION**

**SECTION 06180**  
**GLUED-LAMINATED CONSTRUCTION**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes framing using structural glued-laminated timber.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

**PART 2 - PRODUCTS**

2.1 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
  2. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.
  3. Adhesive shall not contain urea-formaldehyde resins.
  4. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Regional Materials: Glued-laminated timber shall be manufactured within 500 miles of Project site from wood that has been harvested and milled within 500 miles of Project site.
- C. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch that complies with structural properties beam stress clarifications indicated.
- D. Species and Grades for Beams, Rafters and Columns:
1. Species and Beam Stress Classification Douglas fir-larch, 24F-1.8E.
- E. Species and Grades for Arches:
1. Species and Beam Stress Classification: Douglas fir-larch, 24F-1.8E.
- F. Appearance Grade: Premium, complying with AITC 110.

## 2.2 TIMBER CONNECTORS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable product by one of the following:
1. Cleveland Steel Specialty Co.
  2. Simpson Strong-Tie Co., Inc.
  3. USP Structural Connectors.
- B. Materials: Unless otherwise indicated, fabricate from the following materials:
1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
  2. Round steel bars complying with ASTM A 575, Grade M 1020.
  3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.
- C. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil (0.05-mm) dry film thickness.

1. Primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M.

## 2.3 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.
- C. Sealers shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.4 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.
- D. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- C. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing.
  1. Predrill for fasteners using timber connectors as templates.
  2. Finish exposed surfaces to remove planing or surfacing marks.
  3. Coat cross cuts with end sealer.

### 3.2 ADJUSTING

- A. Repair damaged surfaces after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

### 3.3 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
  1. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

## **PART 4 - MEASUREMENT AND PAYMENT**

### 4.1 Glulam (Glued-Laminated) Rafters

- A. This item is measured and paid for by the each of Glulam Rafters in place at the contract unit price bid. Price and payment is full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item.

### 4.2 Glulam (Glued-Laminated) Benches

- A. These items is measured and paid for by the lineal feet of Glulam Benches in place at the contract unit price bid. Price and payment is full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item. The lineal feet measurement is the horizontal distance measured along the front of the bench.

### 4.2 Glulam (Glued-Laminated Members)

- A. These items is measured and paid for by the Thousand Board Feet (MBF) of Glulam in place at the contract unit price bid. Price and payment is full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item.

**END OF SECTION**

## **SECTION 06201**

### **EXTERIOR FINISH CARPENTRY**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Tongue and groove decking and fascia.
- B. See Division 6 Section 06180 for exterior woodwork not specified in this Section.
- C. See Division 9 Section 09930 for exterior wood finishes.

##### **1.2 SUBMITTALS**

- A. Product Data: For finishes indicated.
- B. Samples: Multiple full size lumber samples for exterior fascia and soffits indicated.
- C. Finish Samples: For each finish system and transparent finish color with one-half exposed surface finished.
- D. Manufacturer's documentation of appearance grade.

#### **PART 2 - PRODUCTS**

##### **2.1 MATERIALS, GENERAL**

- A. Lumber: DOC PS 20 and applicable grading rules of inspection agencies certified by ALSC's Board of Review.
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: AHA A135.4.

##### **2.2 SOFFIT LUMBER**

- A. Provide kiln-dried lumber complying with DOC PS 20.
- B. Where indicated to receive an opaque finish, prepare and coat materials with exterior primer per Division 9 Section 09930.



- C. Where indicated to receive a transparent finish, prepare and finish materials as specified in Division 9 Section 09930.
- D. Species and Grade:
  - 1. Grade: Finish Grade per WWPA
  - 2. Species: Douglas-Fir.
    - a. Size: As indicated.

## 2.3 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
  - 1. For applications not otherwise indicated, provide stainless-steel or hot-dip galvanized steel fasteners.
- B. Sealants: Where not exposed to view on materials scheduled to receive transparent finish, latex, complying with ASTM C 834, Type C, Grade NS and with applicable requirements in Division 7 Section "Joint Sealants"; recommended by sealant manufacturer and manufacturer of substrates for intended application.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare and finish exposed wood surfaces with transparent finish; finish both faces and edges. Cut to required lengths and prime ends. Comply with requirements in Division 9 Section 09930.

### 3.2 INSTALLATION, GENERAL

- A. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by finish manufacturer.
- B. Install carpentry with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available.
  - 1. Do not use pieces less than 48-inches long.
  - 2. Span pieces between soffit brackets indicated, except where acceptable to Architect.

- 3. Stagger end joints in adjacent and related members.
- C. Fit exterior joints to exclude water. Cope at returns and miter at corners.

#### **PART 4 - MEASUREMENT AND PAYMENT**

- 4.1 Tongue and groove decking
  - A. This item is measured and paid for by the square feet of Tongue and Groove Decking in place at the contract unit price bid. Price and payment is full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item.

**END OF SECTION**

**SECTION 07210**  
**THERMAL INSULATION**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research/evaluation reports.

**PART 2 - PRODUCTS**

2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company (The).
    - c. Owens Corning.
    - d. Pactiv Building Products.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.1 Rigid Insulation**

- A. This item is measured and paid for by the square feet of Rigid Insulation in place at the contract unit price bid. Price and payment is full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item.

**END OF SECTION**

## SECTION 07411

### METAL ROOF PANELS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Factory formed standing-seam and batten metal roof panels, coping, ridge flashing and venting, and flashing contiguous with panels.
  - 2. Factory formed extruded aluminum, stationary drainable blade louver with insect screen.

##### 1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM).
  - 1. ASTM A 653: Steel Sheet, Zinc-Coated by the Hot Dip Process.
  - 2. ASTM A 792: Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process.
- B. Sheet Metal and Air Condition Contractors National Association, Inc. (SMACNA).
  - 1. SMACNA Architectural Sheet Metal Manual, Current Edition.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- B. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
  - 1. Uplift Rating: UL 90.
- C. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
- D. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
  - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
    - a. Uniform pressure of 20 lbf/sq. ft. acting inward or outward.
  - 2. Snow Loads: 30 lbf/sq. ft.
  - 3. Deflection Limits: Metal roof panel assemblies shall withstand wind and snow loads with vertical deflections no greater than 1/240 of the span.

- E. Install panels over solid deck.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of metal roof panel and accessory indicated.
- B. Shop Drawings: Show fabrication and installation layouts of metal roof panels, including roof plans clips, clip attachment, underlayment and sections of each flashing/trim condition, and attachments to other work including coordination with formed stationary louver vents, ridge caps, details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories. Distinguish between factory- and field- assembled work.
- C. Coordination Drawings: Roof plans, drawn to scale, based on input from installers of the items involved and coordinated with metal roof panel installation with penetrations and roof-mounted items.
- D. Samples:
  - 1. Manufacturer's full color line for each exposed finish for Architect's color selections for roof finish and louvered vent.
  - 2. 12 inch long x full width panel sections showing proposed metal gauge, seam profile and specified finish.
- E. Material certificates.
- F. Field quality-control inspection reports.
- G. Product test reports.
- H. Maintenance data.
- I. Certification: Manufacturer's certification that materials and finishes meet specification requirements.
- J. Warranty.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer with a minimum of ten (10) years of experience in manufacturing architectural roofing.
- B. Panel Installer: Installer shall have a minimum of two (2) years of successful experience in installation of concealed clip architectural standing seam metal roofing with evidence of a minimum of three (3) projects similar in size, scope, and complexity.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including rupturing, cracking, or puncturing.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two (2) years from date of Substantial Completion.
3. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PRODUCT DESCRIPTION**

- A. "PowerSeam" structural standing seam roof system as manufactured by Fabral, 3449 Hempland Road, Lancaster, PA 17601, ph.: 800-477-2741; fax: 800-283-4289, or equal.
- B. The PowerSeam panel shall have a coverage of 12". Seams shall be 2" high.
- C. Roof panels shall use a two-piece roof clip allowing for thermal movement of the panel system.
- D. The panel shall have a factory-applied mastic and be mechanically seamed with a field operated electric seaming machine provided by the manufacturer.
- E. The panel system shall be as a true standing seam shape.
- F. Panels have 1" shadowlines as a standard.

### **2.2 MATERIALS AND FINISHES**

- A. Roof panel materials: 24 gauge, Grade 50 structural steel with G90 (0.90 oz/ft.<sup>2</sup>) hot dipped galvanized coating, both conforming to ASTM A 653.
  1. Texture: Panels shall be smooth.
- B. Finish: 70% polyvinylidene fluoride (Kynar/Hylar fluorocarbon) baked-on coating, factory applied prior to roll forming. The treatment shall be a two-coat system consisting of a single coat of 0.2 mil primer followed by a finish coat of 0.8 mil Kynar topcoat with a total dry film thickness of 1.0 mil  $\pm$  0.2 mil. The reverse side of the panels shall be treated with a back coat system consisting of a 0.2 mil primer with a 0.3 mil topcoat for a total dry film thickness 0.5 mil.

### **2.3 ACCESSORIES**

- A. Concealed roof clips: Clips composed of two pieces and engages the male leg encompassed by the female leg forming a bi-fold interlock. This is then mechanically seamed, creating a five ply double lock standing seam. The clips shall be made from 26 ga. stainless steel.
- B. Flashing and trim: All flashing and trim shall be of the same material, gauge, finish, and color as the roof panels and fabricated in accordance with standard SMACNA procedure and details.
- C. Fasteners:
  1. Clips to substrate: Screws shall be #10 diameter, self-tapping type, zinc-plated steel, with philips pancake head.
  2. Flashings to panels: Exposed screws shall be zinc plated with a #14 combination steel and neoprene washer, color to match panel, of length recommended by manufacturer.
  3. Pop rivets: #43 stainless steel, color finish to match panel.
- D. Sealants:
  1. Manufacturer's recommended sealant for field application for conditions

2. Exposed sealant shall be one-part polyurethane joint sealant. Coordinate color with roof panels.
- E. Closures:
  1. Ridge and hip closures protected and supported by a formed metal closure manufactured from the same material, color, and finish as the panels.
  2. Metal closures shall be factory fabricated and field-cut as needed.
- F. Vapor Retarder:
  1. Retarder with a permeance of 0.05 or less as determined by ASTM E 98.
- G. Underlayments: As indicated and specified.
- H. Snowguards: As indicated.

## 2.4 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide as indicated, or if not indicated as recommended by manufacturer for field conditions.
- B. Slip Sheet: Building paper, as recommended by manufacturer.

## 2.5 METAL ROOF PANELS

- A. Standing-Seam Metal Roof Panels: Factory-formed, designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
  1. Steel Panel Systems: Comply with ASTM E 1514.
  2. Manufacturers:
    3. a. Fabral, Inc.
  4. Type: Vertical rib, in extents indicated on Drawings.
  5. Material: Metallic-coated steel sheet 24 gauge.
    - a. Exterior Finish: Fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.
  6. Clips: Manufacturer's standard two piece clip.
    - a. Material: Stainless-steel sheet.
  7. Joint Type: As standard with manufacturer.
  8. Panel Coverage: 12 inch width.
  9. Height: 2".
  10. Uplift Rating: UL 90.

## 2.6 FABRICATION

- A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
  1. Roof panels shall be formed in continuous lengths. End laps will not be allowed.



- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
- E. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product cartons for installation and SMACNA.

#### **3.2 UNDERLAYMENT INSTALLATION**

- A. Self-Adhering Sheet Underlayment (Ice and Water Shield): Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under metal roof panels. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply as indicated on Drawings. Install in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
- B. Apply slip sheet over underlayment before installing metal roof panels.

#### **3.3 METAL ROOF PANEL INSTALLATION, GENERAL**

- A. General: Provide metal roof panels of full length from eave to ridge. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Field cutting of metal roof panels by torch is not permitted.
  - 2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels.
  - 3. Provide metal closures at peaks, rake edges, rake walls and each side of ridge and hip caps.
  - 4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
  - 5. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

### 3.4 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
  - 1. Install clips to supports with self-tapping fasteners.
  - 2. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  - 3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

### 3.5 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal roof panel assembly including trim fascia wrap, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  - 2. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 3. Provide elbows as required at base of downspouts to direct water away from building.
  - 4. Tie downspouts to underground drainage system indicated.

### 3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 Standing Seam Metal Roofing

- A. This item is measured and paid for by the square feet of Standing Seam Metal Roofing in place at the contract unit price bid. Price and payment is full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item.

**END OF SECTION**

## SECTION 07620

### SHEET METAL FLASHING AND TRIM

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following miscellaneous flashing and trim and reglets necessary for conditions indicated.

##### 1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Show layouts, profiles, shapes, seams, dimensions, and details for fastening, joining, supporting, and anchoring sheet metal flashing and trim.
- C. Samples: Manufacturer's full range of available colors for each type of sheet metal flashing and trim for Architect's selection of colors.

##### 1.3 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated or required by SMACNA for conditions indicated including:
  - 1.
  - 2. Metal Roof and Wall Systems.

#### PART 2 - PRODUCTS

##### 2.1 SHEET METALS

- A. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality (where not exposed to view).
  - 2. Exposed Finishes: Apply the following coil coating:
    - a.
    - b. High-Performance Organic Finish: Three-coat thermocured system containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA 2605, except as modified for below:
      - 1)
      - 2) Color(s) and Gloss: As selected by Architect from manufacturer's full range of available colors and finishes.

## 2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Felt Underlayment: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
  - 1.
  - 2. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft..
- C. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
  - 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
  - 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
  - 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound.
- H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.

## 2.3 REGLETS

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and –welded corners and junctions.
  - 1. Manufacturers:
    - a.
    - b. Cheney Flashing Company, Inc.
    - c. Fry Reglet Corporation.
    - d. Hickman, W. P. Company.
    - e.
  - 2. Material: 24 gauge Galvanized steel.
  - 3. Color: Manufacturer's standard Kynar finish as selected by Architect.

## 2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- D. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- E. Conceal fasteners and expansion provisions on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal, and in thickness not less than that of metal being secured.

## 2.5 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Apron, Step, Cricket, and Backer Flashing: Fabricate from prepainted material to match to metal roof panels.
- B. Valley Flashing, Drip Edges, Eave, Rake, Ridge, and Hip Flashing: Fabricate from prepainted material to match to metal roof panel.
  - 1.
  - 2. Prepainted, Metallic-Coated Steel: 0.0276 inch thick.

## 2.6 WALL SHEET METAL FABRICATIONS

- A. Openings Flashing in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high end dams. Fabricate from the following material:
  - 1.
  - 2. Prepainted, Metallic-Coated Steel: 0.0217 inch thick.

# PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

- 1.
  2. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- H. Seal joints with elastomeric sealant as required for watertight construction.

### 3.2 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49.
- 1.
  2. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 16-inch centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49.
- 1.
  2. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 16-inch centers.
  3. Anchor interior leg of coping with screw fasteners and washers at 18-inch centers.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Secure in a waterproof manner. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
- 1.
  2. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.

3. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

### 3.3 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Reglets: Installation of reglets is specified in Division 3 Section "Cast-in-Place Concrete," 4 Section "Unit Masonry" or if not specified as approved by submitted Shop Drawings. Coordinate questionable condition in the field with the Architect.
- C. Openings Flashing in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings unless otherwise recommended by SMACNA's "Architectural Sheet Metal Manual" for conditions indicated.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 Felt

- A. This item is measured and paid for by the square feet of Felt in place at the contract unit price bid. Price and payment is full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item.

### 4.2 Miscellaneous Fasteners and Steel Connections

- A. This item is not measured for payment but will be paid for as a lump sum. Price and payment is full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item.

**END OF SECTION**

**SECTION 07720**  
**ROOF ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes roof jacks, roof edge drainage systems, and miscellaneous accessories required to complete work indicated.

**1.2 SUBMITTALS**

- A. Product Data: For each type of roof accessory indicated or required.
- B. Shop Drawings: Show fabrication and installation details for roof accessories.
- C. Samples: For each type of exposed factory-applied color finish required and for each type of roof accessory indicated, prepared on Samples of size to adequately show color.
- D. Sample warranty.
- E. Maintenance Data: For Roofing specialties to include in maintenance manuals.

**1.3 QUALITY ASSURANCE**

- A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

**PART 2 - PRODUCTS**

**2.1 METAL MATERIALS**

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.



## 2.2 ROOF-EDGE DRAINAGE SYSTEMS

- A. Gutters: Manufactured in uniform section lengths not exceeding 12 feet or per manufacturer, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch or per manufacturer above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
  - 1. Aluminum sheet .032 inch minimum thickness.
  - 2. Gutter Profile: Box Bead according to SMACNA's "Architectural Sheet Metal Manual".
  - 3. Corners: Factory mitered per manufacturer's recommendation.
  - 4. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching gutters.
  - 5. Gutter Accessories: Flat ends.
- B. Downspouts: Plain rectangular complete with smooth-curve elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
  - 1. Formed Aluminum: .032 inch minimum thickness.
- C. Aluminum Finish: Minimum 2-coat fluoropolymer.
  - 1. Color: As selected by Architect from manufacturer's full range.

## 2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
  - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
  - 2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
  - 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
  - 4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 Stainless steel or hot-dip zinc coated steel according to ASTM A 153/A 153M or ASTM F 2329.
- B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

## 2.4 FINISHES

- A. Unless otherwise indicated, finish all roof flashing, roof edge drainage systems, and accessories to match roof finish color and finish. Coordinate each condition with approved Shop Drawings.
- B. Coil-Coated Aluminum Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
    - b. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
    - c. Two-Coat Mica Fluoropolymer: AAMA 2605. Fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat.
    - d. Three-Coat Metallic Fluoropolymer: AAMA 2605. Fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
- C. Coil-Coated Galvanized-Steel Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
    - b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
    - c. Two-Coat Mica Fluoropolymer: AAMA 621. Fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat.
    - d. Three-Coat Metallic Fluoropolymer: AAMA 621. Fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Install roof accessories to fit substrates and to result in watertight performance.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
  - 3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.
- D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
- E. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.

### **3.2 ROOF-EDGE SPECIALITIES INSTALLATION**

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

### **3.3 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION**

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches (610 mm) apart or per

manufacturer's recommendation. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.

1. Install gutter with expansion joints not exceeding 50 feet (15.2 m) or per manufacturer's recommendation. Install expansion-joint caps.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.
1. Connect downspouts to underground drainage system indicated.

#### **PART 4 - MEASUREMENT AND PAYMENT**

##### **4.1 GENERAL**

- A. Gutters (Galvanized) will be measured and paid for by the lineal foot. Payment for this item includes full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item.
- B. Downspouts (Galvanized) will be measured and paid for by the lineal foot. Payment for this item includes full compensation for all materials, equipment, tools, labor, and for the performance of all work and incidentals necessary to complete the item.

**END OF SECTION**

## SECTION 07920

### JOINT SEALANTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
  - 1. Exterior vertical surfaces and horizontal nontraffic surfaces.
  - 2. Exterior and interior joints in horizontal traffic surfaces.
- B. See Division 7 Sections for roof and flashing sealants.

##### 1.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

##### 1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Compatibility and adhesion test reports.

##### 1.4 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: One (1) year from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: One (1) year from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### **2.2 ELASTOMERIC JOINT SEALANTS**

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:
  - 1. Type and Grade: S (single component) and NS (nonsag).
  - 2. Class: 25.
  - 3. Use Related to Exposure: NT (nontraffic).
  - 4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
- D. Single-Component Nonsag Urethane Sealant:
  - 1. Type and Grade: S (single component) and NS (nonsag).
  - 2. Class: 100/50.
  - 3. Use Related to Exposure: NT (nontraffic).
  - 4. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
- E. Single-Component Pourable Urethane Sealant:
  - 1. Type and Grade: S (single component) and P (pourable).
  - 2. Class: 50.
  - 3. Uses Related to Exposure: T (traffic) and NT (nontraffic).
  - 4. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

### **2.3 JOINT-SEALANT BACKING**

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C, O, or B as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
    - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
  - 2. Remove laitance and form-release agents from concrete.
    - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- B. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior horizontal traffic, isolation and contraction joints in cast-in-place concrete slabs.
  - 1. Joint Sealant: Single-component pourable neutral-curing silicone sealant.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- B. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry and concrete.
  - 1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant, Single-component neutral-curing silicone sealant, Single-component nonsag urethane sealant.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.



## **PART 4 - MEASUREMENT AND PAYMENT**

### **4.1 General**

- A. This item is not measured for payment. This work is incidental to other items in the contract.

**END OF SECTION**

## **SECTION 09930**

### **STAINING AND TRANSPARENT FINISHING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section includes surface preparation and application of wood finishes on the following substrates:
  - 1. Substrates:
    - a. Exposed glued-laminated beams and columns.
    - b. Exposed dimension lumber (rough carpentry).
    - c. Dressed lumber (finish carpentry).
    - d. Wood decks and tongue and groove.
    - e. Wood shingles and shakes (excluding roofs).

##### **1.2 DEFINITIONS**

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

##### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- B. Samples: For each type of finish system and in each color and gloss of finish indicated.
- C. Product List: For each product indicated, include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Stains and Transparent Finishes: 10 percent, but not less than 1 gal. of each material and color applied.

#### 1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 12" x 12".
  - 2. Final approval of stain color selections will be based on mockups.
    - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product listed in other Part 2 articles for the category indicated.

#### 2.2 MATERIALS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
  2. Shellacs, Clear: VOC not more than 730 g/L.
  3. Stains: VOC not more than 250 g/L.
  4. Primers, Sealers, and Undercoaters: 200 g/L.
- D. Colors: As selected by Architect from manufacturer's full range.

## 2.3 WOOD FILLERS

- A. Wood Filler Paste: MPI #91.

## 2.4 OIL FINISH

- A. Penofin:
1. Penofin; Ultra Red Premium Red Label Brazilian Rosewood Oil.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
  - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.
  - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
  - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

### 3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Manual."
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

### 3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Wood substrates, nontraffic surfaces, including wood trim architectural woodwork glued-laminated construction exposed joists exposed beams, and tongue and groove decking.
  - 1. Danish Oil System:

- a. Prep: Penofin Pro-Tech Cleaner.
- b. Prime Coat: Penofin Oil.
- c. Topcoat: Penofin Oil.

#### **PART 4 - MEASUREMENT AND PAYMENT**

##### **4.1 General**

- A. This item is not measured for payment. This work is incidental to other items in the contract.

**END OF SECTION**

## **SECTION 13120**

### **FWP PARKS STYLE VAULT TOILET BUILDING**

#### **PART 1: GENERAL**

##### **1.1 DESCRIPTION**

- A. This specification covers the construction and placing of a precast concrete single user vault toilet building. Acceptable models include the “Aspen” manufactured by Missoula Concrete Construction, “Gunnison” and “Double Rocky Mountain” manufactured by CXT Concrete Buildings, or approved equal.
- B. Furnish and install two Vault Concrete Toilets (VCT). The precast concrete vault toilet located in the Gateway Parking Lot area shall be a single vault model and precast concrete vault toilet located in within Parking Area A shall be a double vault model.

##### **1.2 SUBMITTALS**

###### **A. Samples and Submittals**

The supplier will be required to submit a document that demonstrates that the latrines meet the listed salient requirements of these specifications. At a minimum, the submittal shall consist of the following categories:

- Floor plan with gross dimensions
- Elevations
- Concrete mix design(s)
- Interior and exterior paint for concrete and steel
- Caulking
- Toilet riser
- Grab bars
- Toilet paper dispensers
- Steel doors and frames
- Door hinges
- Passage set
- Door louver
- Doorstop
- Double coat hook
- Door sweep
- Windows
- Vault clean out cover
- Vault size and lining

- Exhaust pipe
- Windscreen
- Signage
- Final Cleaning

Submit shop drawings, calculations, and manufacturer's literature to the Engineer for approval at least ten days prior to fabrication or ordering. Mark drawings or literature to show the exact model, size, color, and dimension requirements. Include proposed panel connections, steel reinforcement plan, and engineered calculations on all shop drawings.

After contract award, the provider shall submit a quality control plan that will detail, at a minimum, detailed plans, concrete mix design, concrete forming and placement, steel placement and welding, paint application, final assembly, handling and transport procedures and recommended maintenance practices. List all standards and testing that will be performed. Copies of test results shall be submitted to the Engineer.

The recommended maintenance practices manual shall contain, at a minimum, the following items.

- General information on maintenance practices and intervals,
- Sources for replacement parts,
- Care and cleaning of painted surfaces,
- Paint and caulk repair,
- Concrete crack repair,
- Tools and techniques for repair/replacement for vandal proof hardware.

#### B. Warranty

Provide manufacturer's warranty information upon completion of project.

### 1.2 DESIGN CRITERIA

The latrine shall be designed to meet the following criteria:

- A. Snow Load: Withstand a snow load of 250 pounds per square foot.
- B. Wind Load: Withstand the effects of 120 mile per hour wind load (fastest mile) or 150 mph (3-second gust) Exposure C.
- C. Earth Quake: Withstand the effects of a zone 4 earthquake.
- D. Additional Design Standards



1. Meet the requirements of the Americans with Disabilities Act and Uniform Federal Accessibility Standard as of the date of these specifications.
2. Incorporate all design aspects of Sweet Smelling Technology as outlined by Brian Cook for the U.S. Forest Service. ("In Depth Design and Maintenance Manual for Vault Toilets" - July 1991 - Publication No. 9123 1601)
3. Utilize a one-piece vault unit to support the building, screen area and snow loads evenly, and utilize a one piece pre-stressed floor unit.

E. Tolerances: Tolerances shall be within the limits as dictated by the PCI Quality Control and Assurance Manual.

## **PART 2: MATERIALS**

### **2.1 PRECAST CONCRETE VAULT TOILET**

#### **A. Concrete - General**

The concrete mix design shall be designed to ACI 211.1 to produce concrete of good workability.

1. Concrete shall contain a minimum of 675 pounds cement per cubic yard.
2. Cement shall be low alkali type I-II or type III conforming to ASTM C-150
3. Coarse aggregates used in the concrete mix design shall conform to ASTM C33 with the designated size of coarse aggregate #67.
4. Minimum water/cement ratio shall not exceed 0.45. Slump shall not exceed 5" with normal water reducing agent or 7" with super plasticizer.
5. Air-entrained admixtures shall conform to ASTM C260. Water reducing admixtures shall conform to ASTM C494, Type A. Plasticizing admixtures shall conform to ASTM C 1017. Other admixtures shall not be used without customer approval.

#### **B. Colored Concrete**

1. Color additives shall conform to ASTM C979. A minimum 6"x12"x1" color sample shall be available for customer approval.
2. The following shall contain colored concrete:
  - a. Toilet building roof panels
  - b. Building walls
  - c. Screen panels
3. The sample brand and type of color additive shall be used throughout the manufacturing process.
4. All ingredients shall be weighed and the mixing operation shall be adequate to ensure uniform dispersion of the color.

#### **C. Cold Weather Concrete**

1. Cold weather concrete placement shall be in accordance with ACI 306.

2. Concrete shall not be placed if ambient temperature is expected to be below 35 degrees F during the curing period unless heat is readily available to maintain the surface temperature of the concrete at least 45 degrees F.
3. Materials containing frost or lumps of frozen materials shall not be used.

#### D. Hot Weather Concrete

The Temperature of the concrete shall not exceed 95 degrees F at the time of placement. When the ambient temperature reaches 90 degrees F, the concrete shall be protected with moist covering.

#### E. Concrete Reinforcement

1. All reinforcing steel shall conform to ASTM A615. All welded wire fabric shall conform to ASTM A185.
2. All reinforcement shall be new, free of dirt oil. Paint, grease, and loose mill scale and loose or thick rust when placed.
3. Details not shown on drawings or specified shall be to ACI 318.
4. Steel reinforcement shall be centered in the cross-sectional area of the walls and shall have at least 1" of cover on the under surface of the floor and roof.
5. The maximum allowable variation for center-center spacing of reinforcing steel shall be 1/2".
6. Full lengths of reinforcing steel shall be used when possible.
7. Reinforcing bars shall be bent cold.

#### F. Sealers and Curing Compounds

1. Curing compounds, if used, shall be odorless, complying with ASTM C309 type I or I-D.
2. Weatherproofing sealer for exterior of building shall be clear, low gloss, water repellent sealer.

#### G. Caulking, Grout, Adhesive and Sealer

1. All caulking shall remain flexible and non-sag at temperatures from -40 to 140 degrees F.
2. Interior and exterior joints shall be caulked with a sealant that is paintable or closely matches the exterior concrete color.
3. Epoxy concrete adhesive shall be two-component rigid, non sag gel adhesive for bonding to dry or damp surfaces, moisture insensitive.
4. Grout shall be a non-shrink type and be painted to match the color of surrounding concrete.

#### H. Paint

All paints and materials shall conform to all Federal specifications or be similar "top-of-the-line components". Paints shall be classified as lead free.

1. Interior floor shall be minimum 2 coats of 2-part water based epoxy or chemical resistant urethane. Color shall be gray.
2. Interior walls and ceiling shall be minimum 2 coats of acrylic emulsion, or water repellent penetrating stain followed by 1-coat clear acrylic sealer. Color shall be white.
3. Metal surfaces both inside and out shall be minimum 1 coat primer and 2 coats of enamel. Color shall be dark brown.
4. Exterior slab shall be 1 coat of clear sealer.
5. Exterior walls shall be minimum 2 coats of acrylic water repellent penetrating stain in the same color as the walls followed by 1 coat of clear acrylic sealer.
6. Simulated shake roof shall be minimum one heavy coat of pure linseed oil, or 2 coats water repellent penetrating stain in the same color as the roof followed by a clear acrylic sealer.

#### I. Grab bars

1. Grab Bars shall be 18-gauge type 304 stainless steel with 1-1/2 inch outside diameter, and 1-1/2 inch clearance between the bar and wall when mounted. Grab bars and mounting shall be able to withstand a minimum of 300 pounds force of top loading and 300 pounds of horizontal pull out load. Cast-in-place inserts shall be used to mount and anchor grab bars.
2. Mounting screws shall be concealed to prevent removal and vandalism. The bar lengths and locations shall be in accordance with the current ADAAG standards.

#### J. Toilet Paper Dispenser

1. Two dispensers shall be installed. The dispensers shall be constructed of at least 1/4 inch steel with a rust proof finish and shall be able to hold three standard rolls of toilet paper. They shall be equipped with a friction device to reduce waste. The units shall simulate a slide bar type device where the bar can be easily removed to install a paper and shall have a 3/8 inch hole to accommodate a standard pad lock. Mounting shall be able to withstand a minimum of 300 pounds force of top loading and 300 pounds of horizontal pull out load. Cast-in-place inserts shall be used to mount and anchor dispensers.
2. Mounting screws shall be concealed to prevent removal and vandalism. The location shall be in accordance with the current ADAAG standards.

#### K. Toilet Riser

1. Riser shall be a seamless design using a cross-linked polyethylene material, complete with molded plastic heavy duty open front seat and cover assembly. It shall be designed for an airtight stable fit in the concrete floor slab. It shall be white in color.

2. The height of the top of the closed riser, seat and cover shall be between 17 and 19 inches without the use of shims, spacers or other devices.
3. Sealant shall be applied between the riser and concrete floor slab before it is installed. A bead of sealant shall be applied to the joint of the riser and floor after it is placed in the floor slab.

#### L. Steel Doors

1. Doors shall be flush panel type 1-3/4" thick, minimum 16 gauge prime coated galvanized steel panels, level 3 Extra Heavy-duty.
2. Door frames shall be knockdown or welded type, single rabbet, minimum 16 gauge prime coated galvanized steel, width to suit wall thickness. Three (3) rubber door silencers shall be provided on latch side of frame.

#### M. Door Hinges

Door hinges shall be 3 per door with dull chrome plating 4 1/2"x 4 1/2", adjustable tension automatic-closing for each door. Opening and closing force on the door shall meet ADAAG maximum of 5 pounds force. The finish on the hinges shall be compatible with the door handles.

#### N. Passage Set

Passage set shall be a type with both levers always unlocked. The handles shall meet current ADAAG specifications. An ADA approved privacy latch is required separate from the handle, which shall have exterior emergency opening capabilities.

1. The inside and outside lever handles shall be 5 inches in length.
2. Finish shall be U.S. 26D or 32D finish.
3. Provide Best passage set
4. Provide a National 151-118 Series B-832 slide bar with a 3/8 inch hole drilled in the bar for a standard pad lock. Slide bar shall be mounted on the exterior with tamper proof fasteners approximately 6 feet above finished floor.

#### O. Door Louvers

Door louvers shall have a security grille to protect louvers from vandalism. Louver shall be fixed, inverted split Y, non-vision, 18 gauge cold rolled steel with a factory prime coat. Louver shall have an insect screen installed between louvers. Security grille shall be 16 gauge cold rolled steel. The bottom of the louver shall be within 3 to 6 inches of the bottom of the door.

#### P. Doorstop

A durable bumper shall be placed on the wall or door to prevent damage. It shall have a metal base and be a concave shape. Montana Fish, Wildlife & Parks will not allow ground mounted stops due to the potential for tripping hazards.

Q. Door Coat Hook

Coat hooks shall be constructed of type 304 stainless or solid brass with a brushed chrome finish. Hooks shall be side by side “ram horn” style with minimal projection (not more than 2 inches) for safety.

R. Door Sweep

Door sweep shall be provided at the bottom of door and be an adjustable brush type.

S. Windows

1. Windows and cleanout cover frames shall be constructed from steel.
2. Window glazing shall be minimum 1/4" thick clear polycarbonate pebble finish and shall be secured to frame with tamper proof fasteners.

T. Vault

1. The vault shall be constructed of precast reinforced concrete and be delivered as an entire unit. The vault shall be a minimum of 1000 gallons and lined with one-piece LDPE or ABS plastic.
2. The concrete vault shall be of sufficient wall thickness and strength to resist loads from the latrine super structure, hydrostatic forces, lateral soil loads and shall also resist uplift from groundwater.
3. The plate for the exterior vault clean out cover shall be a minimum of 1/4 inch thick steel. The lid shall be hinged and configured so that it can be locked with a standard pad lock. The cover, hinges, and locking device shall be painted in accordance with this specification.
4. A neoprene gasket shall be provided around the entire perimeter of the lid to provide an airtight seal. The gasket shall be secured to either the steel cover or concrete vault to prevent it from being displaced.

U. Exhaust Pipe

1. The exhaust pipe shall be Polyethylene (PE) plastic pipe, 12 inch nominal size diameter with a minimum wall thickness of 0.392 inch. It shall be black with a minimum of 2% carbon black and UV stabilized, and extend a minimum of 3 feet above roof peak.
2. After exhaust pipe is installed, sealant shall be applied at all openings through concrete vault and roof.

## V. Signage

1. Exterior signage shall be unisex with raised pictograms, letters and Braille to meet ADA requirements.
2. A sign stating the following shall be placed in the interior of the unit:

*“PLEASE...  
DO NOT place trash  
in the toilet. It is extremely  
difficult to remove.  
THANK YOU.”*

3. Sign locations shall have a recessed wall area with beveled edges and the signs shall be mounted with tamper proof mechanical fasteners to resist vandalism.

### 2.2 BEDDING FOR PRECAST CONCRETE VAULT TOILET

- A. Bedding for the precast concrete vault toilet shall meet the following gradation:

**Bed Course Gradation**

<b>Sieve Size</b>	<b>Percent by Mass Passing Designated Sieve (AASHTO T 27 &amp; T 11)</b>
3/4 inch	100
No. 200	0 – 10

## PART 3: MANUFACTURE

### A. Mixing and Delivery of Concrete

Mixing and delivery of concrete shall be in accordance with ASTM C94, section 10.6 through 10.9 with the following additions:

1. Aggregate and water shall be adjusted to compensate for differences in the saturated surface-dry conditions.
2. Concrete shall be discharged as soon as possible after mixing is complete, not exceed 30 minutes.

### B. Placing and Consolidating Concrete

Concrete shall be consolidated by the use of mechanical vibrators. Vibrations shall be sufficient to accomplish compaction but not to the point that segregation occurs.

### C. Finishing Concrete

1. Interior floor and exterior slabs shall be floated and troweled until all marks are removed. A light broom finish shall be applied to the exterior and interior slabs for a non-slip finish.
2. All exterior building walls and exterior screen walls shall be a barnwood texture, unless otherwise specified.
3. All exterior surfaces of the roof panels shall be cast to simulate a cedar shake roof, unless otherwise specified. The underside of the overhang shall have a smooth finish.

#### D. Cracks and Patching

1. Cracks in concrete components that are judged to affect the structural integrity of the building will be rejected.
2. Small holes, depressions and rock pockets shall be patched with a suitable material. The patch shall match the color, finish and texture of the surrounding surface.
3. Patching will not be allowed on defective areas if the structural integrity of building is affected.

#### E. Curing and Hardening Concrete

1. Concrete surfaces shall not be allowed to dry out from exposure to hot, dry weather during the initial curing period.
2. Curing compounds shall not be used on interior walls as they will prevent paint adhesion.

### **PART 4: FINISHING AND FABRICATION**

#### A. Structural Joints

1. All welding shall be by Certified Welders only (in accordance with AWS D1.1).
2. Wall components shall be joined together with 2 welded plate pairs at each joint. Weld plates shall be anchored into the concrete panels and welded together with a continuous weld.
3. Walls and roof shall be joined with weld plates, minimum 2-1/2"x5", at each building corner.
4. The joint between the floor slab and walls shall be joined with a grout mixture on the inside, a matching colored caulk on the outside, and two weld plates 6" long per wall.

#### B. Painting

1. An appropriate curing time shall be allowed before paint is applied to concrete.
2. Some applications may require acid etching. A 30% solution of hydrochloric acid shall be used, flushed with water and allowed to thoroughly air dry.
3. Painting shall not be done outside in cold, frosty or damp weather.
4. Painting shall not be done outside in winter unless the temperature is 50 degrees F or higher.
5. Painting shall not be done in dusty areas.

6. All surface voids to be filled prior to painting.
7. Schedule of finishes shall be per Section 3.

## **PART 5: QUALITY CONTROL AND INSPECTION**

### **A. Pre-pour inspection.**

1. Check all panel measurements including diagonals (must be within ¼ inch).
2. Check rebar spacing and clearance.
3. Check location of all embeds.

### **B. Concrete Testing**

The following tests shall be performed on concrete used in the manufacture of toilets. Testing shall only be performed by qualified individuals who have been certified ACI Technician Grade 1. Sampling shall be in accordance with ASTM C172.

1. The slump of the concrete shall be performed on the first batch of concrete in accordance with ASTM C143. This slump shall be in the 3"-5" range.
2. The air content of the concrete shall be checked per ASTM C231 on the first batch of concrete. The air content shall be in the range of 4%-6%.
3. The compressive strength of the cylinders shall be tested to ASTM C39.



4. Test cylinders shall be taken from each batch.
  - a. 1 cylinder shall be tested prior to removal of forms and must be at 2,500 psi or higher.
  - b. 1 cylinder represents 7 day strength
  - c. 2 cylinders shall represent 28 day strength and must be 4,500 psi or greater.

**C. After Form Removal Inspection**

1. Recheck panel dimensions
2. Verify that all embeds remained in place.
3. Look for all cracks or blemishes that may cause rejection.
4. Assure that panels are properly yarded and blocked.

**PART 6: INSTALLATION**

- A. Design all lifting lugs, threaded anchors, etc. used by the Contractor to assemble concrete building components to be reusable at a later date if needed to relocate the building or replace building components.
- B. Excavate according precast vault toilet manufacture's recommendations. Compact the natural ground at the bottom of the vault excavation to 95% of maximum laboratory dry-density per AASTHO T-99. Place bed course in layers not exceeding 6" in depth. Compact the bed course layers.
- C. Ensure that the foundation elevation is set according to the manufactures recommendation. Backfill around structure and compact backfill to 95% of maximum laboratory dry-density per AASTHO T-99. Remove all rocks from within 6 inches of the vaults edge during compaction.
- D. Apply silicone caulk between toilet riser flange and concrete floor before the toilet riser is installed. Seal around pipe exhaust vent and roof after vent installation. Seal at top and under roof at vent. Seal around vent where vent penetrates flooring.

**PART 4: MEASUREMENT AND PAYMENT**

**4.1 PRECAST CONCRETE VAULT TOILETS**

- A. This item is measured and paid for by the number of double and single unit vault toilets as shown on the Schedule of Items, assembled in-place and operational, including the necessary excavation, backfill and incidental items. Where no item is shown in the bid schedule for work incorporated into and associated with the building, include costs for such work in related items.

**END OF SECTION**

## **SECTION 16000**

### **ELECTRICAL**

#### **PART 1 - GENERAL**

##### **1.1 DESCRIPTION**

- A. The contractor shall furnish and install two electrical services, a parking lot light, and LED trail lighting along with underground direct bury conductor and conduit sleeves as indicated on the Drawings.
- B. Types of electrical work specified in this section include the following:

Raceways including:

- Electrical metallic tubing (EMT).
- Flexible metal conduit.
- Rigid Steel Conduit (RSC).
- Liquid-tight flexible metal conduit.
- Rigid metal conduit.
- Rigid nonmetallic conduit.

Electrical connections including:

- To panels

Interior equipment:

- Outlet boxes and covers.
- Cabinets, junction boxes, and pull boxes.
- Wires and cables.
- Splices and termination components.
- Device plates.
- Switches.
- Receptacles.
- Panelboards.
- Accessories

Grounding:

- Grounding rods.
- Service equipment.
- Equipment.

##### **1.2 LAWS AND REGULATIONS**

- A. Codes And Standards. Comply with these specifications, project drawings, and all applicable local, State, and Federal laws, codes, standards, and regulations. In the

event of differing requirements, the most stringent applies. Applicable portions of the following shall apply:

1. Building, other structures, and all facilities or systems with electrical installations within the scope of the National Electrical Code (NEC) published by the National Fire Protection Association (NFPA 70).
- B. Inspections and Fees. Inspection and approval by the State or local Electrical Inspector will be required prior to acceptance by the Engineer.
1. The contractor is responsible for obtaining and paying all necessary State, local, and NorthWestern Energy permits and inspections.
- C. Special Requirements. The following are special requirements which may be more restrictive than the code:
1. Hot wires, neutral and ground wires are the same size unless otherwise indicated.
  2. A ground wire must be pulled in all raceways regardless of raceway construction. Raceways shall not be used as the only ground conductor.
  3. All connections must be torqued to specifications using a torque wrench.
  4. Series rated breakers will not be allowed unless specifically authorized.
  5. All neutral conductors must be insulated.
  6. The neutral connection lugs of a duplex outlet shall not be used for connecting the in and out neutral conductors. Generally a pigtail will be required.
  7. A ground wire must be installed for each circuit. A common ground wire for several circuits, even if located in the same conduit, is not allowed.

### 1.3 GENERAL REQUIREMENTS

- A. Grounding. A ground wire shall be installed in all new circuits.
- B. Neutral Size. All circuits shall have a full sized insulated neutral. In no case shall a neutral conductor be used in common with any other circuit.
- C. Conductor Type. The conductor type is THWN copper conductors in EMT conduit above grade and Schedule 80 PVC below grade, unless otherwise indicated.

- D. Boxes. All outlet, switching, and junction boxes shall be metal regardless of wiring method.

#### 1.4 QUALITY ASSURANCE

##### A. Installer's Qualifications:

- 1. Firm with at least 3 years of successful installation experience on projects with electrical work similar to that required for this project.

##### B. UL Standards:

###### 1. UL Compliance and Labeling:

- a. Comply with applicable requirements of U.L. safety standards pertaining to electrical systems. Provide electrical equipment, products, and components which have been UL-listed and labeled.

###### 2. UL Standards

- a. Comply with UL Standard 486A, "Wire Connectors and Soldering lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated.
- b. Comply with applicable requirements of UL Standards Nos.467 and 869 pertaining to electrical grounding and bonding.

###### 3. NEC Compliance:

- a. Comply with applicable requirements of NEC (NFPA 70) pertaining to construction and installation of electrical systems.

##### C. ANSI Compliance:

- 1. Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical systems and equipment.

#### 1.5 SUBMITTALS

##### A. General contractor is responsible to:

- 1. coordinate project requirements involving more than one trade;
- 2. is responsible to coordinate between trades and equipment suppliers;

3. is responsible for performance of subcontractors to verify that equipment delivered to the project site for installation is in compliance with project plans and specifications;
  4. must verify that such equipment will properly interface with equipment specified by other trades for installation and use on the project.
- B. Product Data. Submit manufacturer's technical product data, including specifications and installation instructions, for each type of electrical equipment required. Include data substantiating that materials comply with requirements following the procedures in this specification.

## **PART 2 - PRODUCTS**

### **2.1 METAL CONDUIT AND TUBING**

A. General:

1. Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thickness) for each service indicated.
2. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.

B. Rigid Steel Conduit (RSC):

1. Provide rigid steel, zinc-coated, threaded type conforming to FS WW-C-581, ANSI C80.1 and UL 6.
2. Provide zinc-coating fused to inside and outside walls.

C. Flexible Metal Conduit:

1. FS EE-C-566 and UL 1. Formed from continuous length of spirally wound, interlocked zinc-coated strip steel.

D. Liquid-Tight Flexible Metal Conduit:

1. Provide liquid-tight flexible metal conduit; construct of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC).

E. Rigid Metal Conduit Fittings:

1. Cast malleable iron, galvanized or cadmium plated, conforming to FS W-F-408.
2. Use Type 1 fittings for raintight connections.
3. Use Type 2 fittings for concrete tight connections.
4. Use Type 3 fittings for other miscellaneous connections.

F. Flexible Metal conduit Fittings:

1. Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type.
  - a. Straight Terminal Connectors:
    - (1) One piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
  - b. 45° or 90° Terminal Angle Connectors:
    - (1) Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

G. Liquid-Tight Flexible Metal Conduit Fittings:

1. FS W-F-406, Type 1, Class 3, Style G.
2. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated, or noninsulated throat.

H. Electrical Metallic Tubing (EMT):

1. FS WW-C-563, ANSI C80.3 and UL 797.

I. EMT Fittings:

1. FS W-F-408.
2. Use Type 1 fittings for raintight connections.

3. Use Type 2 fittings for concrete tight connections.
4. Use Type 3 fittings for miscellaneous connections.

## 2.2 NONMETALLIC CONDUIT

### A. General:

1. Provide nonmetallic conduit, ducts and fittings of types, sizes and weights for each service indicated.
2. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements which comply with provisions of NEC for raceways.

### B. Electrical Plastic Tubing (EPT):

1. NEMA TC 2, Type 1, for encasement in concrete.

### C. Electrical Plastic Conduit:

1. Extra Heavy Wall Conduit:
  - a. Schedule 80, UL-rated, construct of polyvinyl chloride compound C-200 PVC, and UL-listed in accordance with NEC Article 347 for direct burial, or above ground use.

### D. PVC Conduit and Tubing Fittings:

1. NEMA TC 3, mate and match to conduit and tubing type material.

### E. Conduit and Tubing Accessories:

1. Provide conduit, tubing and duct accessories of types, sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

## 2.3 CONDUIT BODIES

- A. Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements.
- B. Construct conduit bodies with threaded-conduit-entrance ends, removable covers, either cast or of galvanized steel, and corrosion-resistant screws.

## 2.4 WIREWAYS

### A. General:

1. Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated.
2. Provide complete assembly of raceway including, but not limited to couplings, offsets, elbows, expansion joints, adapters, hold down straps, end caps, and other components and accessories as required for complete system.

### B. Lay-In Wireways:

1. Construct lay-in wireways with hinged covers, in accordance with UL 870 and with components UL-listed, including lengths, connectors, and fittings.
2. Select units to allow fastening hinged cover closed without use of parts other than standard lengths, fittings and connectors.
3. Construct units to be capable of sealing cover in closed position with sealing wire.
4. Provide wireways with knockouts.
5. Connectors:
  - a. Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached that removal is not necessary to utilize the lay-in feature.
6. Finish:
  - a. Protect sheet metal parts with rust inhibiting coating and baked enamel finish.
  - b. Plate finish hardware to prevent corrosion.
  - c. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.



C. Raintight Wireway:

1. Construct raintight lay-in wireways with hinged covers, in accordance with UL 870 and with components UL-listed, including lengths, connectors and fittings.
2. Design units to allow fastening hinged cover closed without use of parts other than standard lengths, fittings and connectors.
3. Construct units to be capable of sealing cover in closed position with sealing wire. Provide wireway units with knockouts only in bottom of troughs.

D. Raintight Troughs:

1. Construct in accordance with UL 870, with components UL-listed.
2. Construction:
  - a. 16-gage galvanized sheet metal parts for 4" x 4" to 6" x 6" sections, and 14-gage parts for 8" x 8" and larger sections.
  - b. Provide knockouts only in bottom of troughs, with suitable adapters to facilitate attaching to other NEMA 3R enclosures.
  - c. Do not use gasketing that can rip or tear during installation, or would compromise raintight capability of trough.
  - d. Do not use cover screws that will protrude into the trough area and damage wire insulation.
3. Finish:
  - a. Provide 14-gage and 16-gage galvanized sheet metal parts with corrosion-resistant phosphate primer and baked enamel finish.
  - b. Plate hardware to prevent corrosion.

## 2.5 WIRES, CABLES, AND CONNECTORS

A. Wires/Cables:

1. Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Reduced size ground

conductors are not allowed unless expressly permitted on the drawings or in the specification.

2. Provide copper conductors with conductivity of not less than 98 percent at 20°C (68°F).
3. Conductors shall be copper THWN, THHN, OR XHHW unless otherwise indicated.
4. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be used.

B. Connectors and Terminals:

1. Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.

C. Aluminum Conductors:

1. Aluminum conductors shall be of an aluminum alloy that is listed or labeled by UL as "component aluminum-wire stock (conductor material)."
2. Type EC/1350 aluminum is not acceptable.

D. Bonding Ground Conductors:

1. ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger.
2. Copper braided tape, constructed of 30-gage bare copper wires and properly sized for indicated applications.
3. Flexible flat conductor, 480 strands of 30-gage bare copper wire; 3/4" wide, 9-1/2" long; 48,250 cm. Protect braid with copper bold ends with holes sized for 3/8" diameter bolts.

## 2.6 SPLICES AND TERMINATION COMPONENTS

- A. UL 486A and UL 486B, as applicable for wire connectors, and UL 510 for insulating tapes.
- B. Connectors for wires No. 10 AWG and smaller shall be insulated pressure-type in accordance with UL 486A or UL 486C twist-on splicing connector.

- C. Provide solderless terminal lugs on stranded conductors.
- D. Electrical Connection Accessories:
  - 1. Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

## 2.7 OUTLET BOXES AND COVERS

- A. UL 514, cadmium- or zinc-coated if of ferrous metal.
- B. Outlet Boxes in Hazardous Locations:
  - 1. UL 886.

## 2.8 CABINETS, JUNCTION BOXES, AND PULL BOXES (WITH VOLUME GREATER THAN 100 CUBIC INCHES)

- A. UL 50, hot-dip zinc-coated if sheet steel.

## 2.9 DEVICE PLATES

- A. Provide UL listed, one-piece device plates for outlets and fittings to suit the devices installed.
- B. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel or cast metal having round or beveled edges.

## 2.10 RECEPTACLES:

- A. General:
  - 1. NEMA 5-20R, specification grade, grounding type.
  - 2. Ratings and configurations shall be as indicated.
  - 3. Bodies shall be ivory thermosetting plastic supported by a metal mounting strap.
  - 4. Connect grounding pole to the mounting strap.

B. Weatherproof Receptacles:

1. Provide in a cast metal box with a gasketed, weatherproof, cover plate and a gasketed cap over each receptacle opening. Receptacle cover shall provide weather protection even with a plug inserted into the receptacle body as required by recent UL changes.
2. The cap(s) shall be provided with a spring-hinged flap.
3. Receptacle shall be UL approved for use in "wet locations."

C. Ground Fault Circuit Interrupter Receptacles:

1. UL 943, and shall be duplex type for mounting in a standard outlet box.
2. The device shall be capable of detecting a current leak of 5 milliamperes.
3. The device shall be NEMA 5-20R.

## 2.11 LOAD CENTERS

A. General:

1. UL 67 and UL 50.
2. Load centers for use as service disconnecting means shall additionally conform to UL 869.
3. Load centers shall be circuit breaker equipped unless indicated otherwise.
4. Design shall be such that any individual breaker can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as a means of obtaining clearances as required by UL.
5. Where "space only" is indicated, make provisions for the future installation of a breaker sized as indicated.
6. Directories shall be typed to indicate load served by each circuit and mounted in a holder behind transparent protective covering.

B. Load center Buses:

1. Support bus bars on bases independent of the circuit breakers.
2. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping.

3. Provide an isolated neutral bus in each panel for connection of circuit neutral conductors.

C. Circuit Breakers:

1. Federal Specification WC-375, ambient-compensated, thermal magnetic type with interrupting capacity of 10,000 amperes symmetrical minimum.
2. Breaker terminals shall be UL listed as suitable for the type of conductor provided

D. Multipole Breakers:

1. Provide common-trip type with a single operating handle.
2. Breaker design shall be such that an overload in one pole automatically causes all poles to open.
3. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

E. Circuit Breaker with Ground-Fault Circuit Interrupter:

1. UL 1053 and NFPA 70.
2. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect a current imbalance of approximately 5 milliamperes.

## 2.12 FUSES

A. General:

1. Provide a complete set of fuses for each fusible switch, panel and control center.
2. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation.
3. Fuses shall have a voltage rating not less than the circuit voltage.

B. Cartridge Fuses, Current-limiting Type (Class R):

1. UL 198E, Class RK-1, RK-5, time-delay type.

2. Associated fuseholders shall be Class R only.
- C. Cartridge Fuses, Current-limiting Type (Classes J and L):
1. UL 198C, Class J for 0 to 600 amps and Class L for 601 to 6000 amps.

## 2.13 GROUNDING SYSTEMS

### A. General:

1. Except as otherwise indicated, provide electrical grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for complete installation.
2. Where more than one type unit meets indicated requirements, selection is Installer's option.
3. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, and established industry standards for applications indicated.

## 2.14 GROUND RODS

### A. Ground Rods:

1. UL 467.
2. Ground rods shall be the sectional type, copper-encased steel, with minimum diameter of 5/8" diameter by 8'.

## 2.15 ACCESSORIES

### A. Solderless Pressure Conductor Splices:

1. Federal Specification W-D-610C or UL 486.

### B. Vinyl Plastic Tape:

1. Federal Specification HH-I-595B(1) or ASTM C2301-73.

### C. Friction Tape:

1. Federal Specification HH-I-510D or ASTM C69-67 (1972).

D. Connector/Splice Insulators:

1. Open ended, tubular rubber sleeves preassembled onto a removable collapsible core, suitable for buried splices. Conform to NEMA PP-CI 1969.
2. Heat shrink insulating covers, moisture resistant, suitable for buried splices, UL listed.

### **PART 3 - EXECUTION**

#### **3.1 ROUGH-IN**

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

#### **3.2 ELECTRICAL INSTALLATIONS**

- A. Coordinate electrical equipment and materials installation with other site construction components.
- B. Verify all dimensions by field measurements. The civil engineering drawings shall be used for measurements as they are authoritative.
- C. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- D. Where mounting heights are not detailed or dimensioned, install electrical services and overhead equipment to provide the maximum headroom possible.
- E. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- F. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide connection for each service.

#### **3.3 NAMEPLATE DATA**

- A. Provide permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.

- B. Locate nameplates in an accessible location.

### 3.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage and handling.
- B. Store equipment and materials at the site, unless off-site storage is authorized in writing.
- C. Protect stored equipment and materials from damage.
- D. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion.
- E. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

### 3.5 RECORD DOCUMENTS

- A. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned for column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; change orders; concealed control system devices.
- B. Mark drawings to indicate approved substitutions; change orders; actual equipment and materials used.

### 3.6 OPERATION, MAINTENANCE AND WARRANTY INFORMATION

- A. Include the following information in a 3 ring binder of suitable size and organized for convenient reference:
  - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
  - 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.



3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.
5. The manufacturer's installation instruction books or sheets, and parts and/or packing lists.
6. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

### 3.7 INSPECTION

- A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways.
- B. Notify the Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### 3.8 INSTALLATION

- A. General
  1. Install raceways as indicated; in accordance with manufacturer's written installation instructions, and in compliance with NEC, and NECA's "Standards of Installation."
  2. Install units plumb and level, and maintain manufacturer's recommended clearances.
- B. Coordinate with other work including wires/cables, boxes, and panel work, as necessary to interface installation of electrical raceways and components with other work.
- C. Hazardous Locations:
  1. Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for the particular "Class," "division," and "Group" of hazardous locations involved.
  2. Provide conduit and cable seals where required by NFPA 70. All conduit shall have tapered threads.

D. Wiring Methods:

1. Wiring method shall be insulated conductors installed in conduit on the structure, except where specifically indicated or specified otherwise, or required by NFPA 70 to be installed otherwise. Wiring in the ground is as specified, generally aluminum URD direct bury.
2. An insulated equipment grounding conductor shall be provided in all feeder and branch circuits, including lighting circuits.

3.9 INSTALLATION OF CONDUITS

A. General:

1. Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly.
2. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis.
  - a. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.
3. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application.
4. Use roughing-in dimensions of electrically operated unit furnished by supplier.
  - a. Set conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.

B. Conduit Installation:

1. Follow minimum requirements in other areas as follows:
  - a. Use liquid-tight flexible conduit where subjected to one or more of the following conditions:
    - (1) Exterior location.

2. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.
  3. Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.
  4. Size conduits to meet NEC.
  5. Fasten conduit terminations in sheet metal enclosures by 2 locknuts, and terminate with bushing. Install locknuts inside and outside enclosure.
- C. Install conduits so as not to damage or run through structural members.
- D. Exposed Conduits:
1. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.
  2. Install exposed conduit work so as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.
  3. Support exposed conduits by use of hangers, clamps, or clips.
  4. Support conduits on each side of bends and on spacing not to exceed following: up to 1": 6'-0"; 1-1/4" and over: 8'-0".
  5. Run conduits for outlets on waterproof walls exposed.
    - a. Set anchors for supporting conduit on waterproof wall in waterproof cement.
- E. Non-Metallic Conduit:
1. Make solvent cemented joints in accordance with recommendation of manufacturer.
  2. Install PVC conduits in accordance with NEC and in compliance with local utility practices.
- F. Conduit Fittings:
1. Construct locknuts for securing conduit to metal enclosure with sharp edges for digging into metal, and ridged outside circumference for proper fastening.

2. Bushings for terminating conduits smaller than 1-1/4" are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation.
3. Install insulated type bushings for terminating conduits 1-1/4" and larger.
  - a. Bushings are to have flared bottom and ribbed sides.
  - b. Upper edge to have phenolic insulating ring molded into bushing.
4. Bushing of standard or insulated type to have screw type grounding terminal.
5. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs to be specifically designed for their particular application.

### 3.10 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.
  1. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- C. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.
- D. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated.
  1. Exercise care to avoid cutting through tapes which will remain on conductors.
  2. The "ringing" of copper conductors while skinning wire is not acceptable.
- E. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

- F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors.
  - 1. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings.
  - 2. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's Standard 486A.

### 3.11 BOXES, OUTLETS, AND SUPPORTS

- A. Provide boxes in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
  - 1. Boxes for metallic raceways shall be of the cast-metal hub type when located in normally wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 7 feet above interior floors and walkways, and when installed in hazardous areas.
  - 2. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit and nonmetallic boxes may be used with nonmetallic wiring conduit system.
  - 3. Each box shall have the volume required by NFPA 70 for the number of conductors enclosed in the box.
  - 4. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces.
  - 5. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work.

### 3.12 MOUNTING HEIGHTS, CLEARANCES, AND LOCATIONS

- A. General:
  - 1. Mount panelboards, circuit breakers, and disconnecting switches so the height of the operating handle at its highest position will not exceed 78 inches from the floor.
  - 2. Receptacle boxes shall be mounted 12" to the bottom of the box from the finish floor, unless otherwise indicated. Dimensions indicated on

drawings of box location shall define the dimension to the bottom of the box vertically, and to the center of the box horizontally.

3. The contractor shall maintain proper NEC clearances around each panel, load center, and other electrical equipment. Generally, at this time, the clearances are 30 inches in width, by 36 inches in front, extending from the floor to 6 1/2 feet above the floor.
4. Switch boxes shall be mounted a maximum of 48 inches above finished floor, measured to the top of the box. The installation of the switches shall be coordinated with other trades such as tile, sheetrock, and counter back splashes for proper switch/wall finish installations.

### 3.13 SPLICES

- A. Make splices in accessible locations.
- B. Make splices in conductors No. 10 AWG and smaller with an insulated pressure type connector.
- C. Make splices in conductors No. 8 AWG and larger with a solderless connector and cover with an insulation material equivalent to the conductor insulation.

### 3.14 TERMINATING ALUMINUM CONDUCTORS.

- A. Terminate aluminum conductors to copper bus either by:
  1. Inline splicing a copper pigtail to the aluminum conductor (copper pigtail shall have an ampacity at least that of the aluminum conductor).
  2. Utilizing a circumferential compression type, aluminum-bodied terminal lug UL listed for AL/CU, and steel Belleville spring washers, flat washers, bolts, and nuts.
  3. Belleville spring washers shall be of cadmium-plated hardened steel.
- B. Take care to install the Belleville spring washers with the crown up toward the nut or bold head, with the concave side of the Belleville bearing on a heavy-duty, wide series flat washer of larger diameter than the Belleville.
- C. Tighten nuts sufficiently to flatten Belleville and leave in that position.
- D. Lubricate all hardware with joint compound prior to making connection.
- E. Wire brush and apply joint compound to conductor prior to inserting in lug.

- F. Terminate aluminum conductors to aluminum bus by utilizing all-aluminum nuts, bolts, washers, and compression lugs.
  - 1. Wire brush and apply joint compound to conductor prior to inserting in lug.
  - 2. Lubricate all hardware with joint compound prior to making connection; if buss contact surface is unplated, scratch-brush and coat with joint compound (without grit).

### 3.15 COVERS AND DEVICE PLATES

- A. Install with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices.
- B. Plates shall be installed with an alignment tolerance of 1/16 inch.
- C. The use of sectional type device plates will not be permitted.
- D. Plates installed in wet locations shall be gasketed.

### 3.16 INSTALLATION OF ELECTRICAL GROUNDING

- A. General:
  - 1. Install electrical grounding systems where shown, in accordance with applicable portions of NEC, with NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions. Grounding includes but is not limited to:

GROUND ALL EQUIPMENT  
GROUND TO GROUND ROD  
GROUND TO OTHER UTILITIES

- B. Ground all exposed non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in nonmetallic raceways, grounding conductor of nonmetallic sheathed cables, and neutral conductor of wiring systems.
- C. Make ground connection at the main service equipment and extend grounding conductor to the point of entrance of the metallic water service.
- D. Make ground connection to driven ground rods on the exterior of the building. Weld grounding conductors to underground grounding rods or electrodes or use ground clamps approved for underground connections.

- E. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.

### 3.17 GROUNDING CONDUCTOR

- A. Provide an insulated, green-colored equipment ground consisting of the same size and type conductor as the circuit hot conductor for all feeder and branch circuits.
- B. This conductor shall be separate from the electrical system neutral conductor.
- C. Run a separate ground wire for each circuit even if several circuits share the same conduit. In no case shall the ground conductor be used in common for several circuits.

### 3.18 TESTS

- A. Carry out all normal testing and operational checks to assure a complete, safe, and reliable system, including, but not limited to:
  - 1. "Megger" tests for insulation of all feeder conductors, branch circuit conductors larger than #10 AWG, and service entrance conductors, installed in this contract. Test to assure no unsatisfactory leakage phase to phase, phases to neutral, and phases to earth/metallic ground. Maintain written record of test results at project site. Submit test results to the Owner as requested.
  - 2. Circuit continuity as needed for phase identification.
  - 3. Amperage tests to assure proper balancing of loads to the maximum extent possible among phases under operating conditions.
- B. Devices Subject to Manual Operation:
  - 1. Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.
- C. Test on 600-Volt Wiring:
  - 1. Test all 600-volt wiring to verify that no short circuits or accidental grounds exist.
- D. Upon completion of installation of electrical grounding systems, test ground resistance with ground resistance tester.



- E. Where ground tests show resistance to ground is over 25 ohm, take appropriate action in accordance with NEC 250-84.
- F. Circuit all branch circuits as shown, connect to phase and circuit number indicated. Circuit changes shall have prior approval of the Owner.
- G. Correct any discrepancies found as a result of the above tests including replacement of conductors, splices, reconnecting loads, changing phases, installing additional ground rods, etc.

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 SITE LIGHTING AND ELECTRICAL SERVICE**

- A. Site lighting and electrical service will not be measured. Payment for site lighting and electrical service will be lump sum. Payment for this item is full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.

**END OF SECTION**